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Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER

REVEALING YOUR TRUE VOCATION

See Page 514

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How Charles Wilson Jumped to $600 a Month

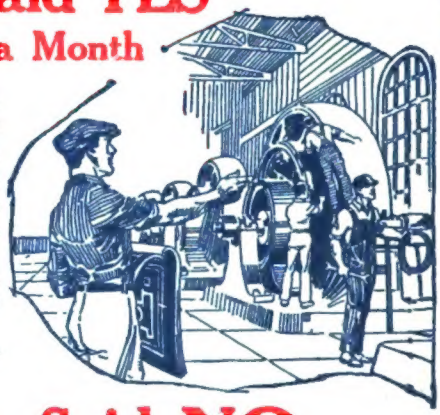
One morning, three years ago, two brothers, Charles and John Wilson, dropped into my office for a little man-to-man talk on the future. At that time John was driving a delivery wagon—Charles was a clerk in a grocery store. Both were earning about $20.00 a week and could see nothing ahead except long hours at small pay.

Having heard of the big opportunities in the Electrical Field, and my easy home-study Course in practical electricity, they came to me for advice.

"Boys," I told them, "if you will follow my easy course of training, which I will outline for you, you can qualify in a very short time as Electrical Experts and be ready to earn at least $75 to $100 a week."

Charles Wilson Said YES

And Today Earns $600 a Month



Charles Wilson promptly agreed to follow my instructions, and that week took up the study of my course in Practical Electricity. He made rapid progress with the various lessons. And, by doing practical work on the side, with the tools which I gave him, more than paid for the course through spare-time work.

He graduated as an Electrical Expert in less than a year. And in the two years since he finished my course has made wonderful progress. Today he earns $600 a month as an Electrical Expert.

A prompt *yes*, three years ago, coupled with back-bone and the determination to get ahead, has brought him big success.

John Wilson Said NO

And Still Earns $85 a Month

John Wilson, the younger of the two brothers, could not see the big possibilities of my plan—he wanted to "think it over," "talk to his friends," "would come back and see me again," etc. And, as is usually the case when a man delays action, he failed to do anything definite. He drifted along, month after month in the same old job, at the same old pay.

The other day John Wilson dropped into my office again. "Mr Cooke," he said, "three years of foolish indecision have cost me thousands of dollars, I say this because Charles, who wrote me yesterday of his new position, is now earning $600 a month as an Electrical Expert.

I have simply wasted three years. Now I want you to start in and do for me just what you did for Charles. I want to start today to make up for lost time."

You, Too, Can Earn $600 a Month—*Even More*

How long will *you* stay in the "John Wilson" class? Why should *you* work for $20 to $30 a week when with a few months training under me, through my Home Study Course in Practical Electricity you too can quickly fit yourself for a big-pay job and be ready to earn *your* $3500 to $10,000 a year.

I know exactly the kind of training you need for a big-pay job. And I give you that training. I furnish you with a complete set of fine electrical tools and instruments *free of charge*. I positively guarantee your success and satisfaction.

Fill in the coupon and mail it today for my Big *Free* Book, "How to Become an Electrical Expert," and full particulars on my course in Electricity.

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THE COOKE TRAINED MAN IS THE "BIG-PAY MAN"

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Vol. IX
Whole No. 102

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

October, 1921
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ZR-2

NEXT to the sinking of the ill-fated "Titanic," the disaster that befell the ZR-2 dirigible, late last August, will probably rank for a long time as the greatest in all transportation. It is almost certain that the disaster will not stop the future building of dirigibles of the ZR-2 type, altho the present rigid types are a scientific monstrosity.

The principle is wrong all the way thru. Perhaps poor engineering was applied in the building of the ZR-2; certainly structural weaknesses were present almost from the start. But in a monster airship of this type an engineer quickly comes to his wits' ends. The framework must of necessity be extremely light. It is therefore made of an aluminum alloy. If we increase the weight of the framework only 10%, to make it stronger, the lifting capacity of the ship is reduced at once. On the other hand, the framework cannot go beyond a certain weight, because the gas cannot then lift it any longer. It should always be borne in mind that a rigid dirigible is nothing but a floating bridge, or a skyscraper for that matter. But no bridge or skyscraper is ever subjected to such terrific stresses as is a modern dirigible. First we have tremendous wind pressures, due to its high speed, and not evenly distributed, for the whole ship. Then when a sharp turn is negotiated, the stress on the longitudinal girders becomes truly frightful due to the great length of the ship; it is in reality a titanic lever action that results.

If the ship were truly rigid, things might not be so bad, but you cannot build an 800-foot framework rigid, not even that represented by an ocean liner, which is at least many hundred times as stiff. No, the dirigibles of the ZR-2 type are far from rigid. They undulate—wobble—badly. One of the survivors of the ZR-2 noted that the "cat-walk"—altho supposedly level—undulated like a scenic railroad track. Now, once a huge frame like the ZR-2 hits airpockets, or makes a sharp turn, the entire framework oscillates badly. Extraordinary stresses are set up thruout the framework. If the wobbling and undulating go beyond a certain point—the critical elasticity limit of the metal—the frame will acquire a permanent bend, and soon something must give way. Girders snap one after the other in a fraction of a second, and the disaster is complete.

Then again there are still other stresses—the internal ones resulting from the gas bags pressing against the upper girders, which they must do if the framework is to be lifted. All such unequal, unevenly distributed stresses try the framework past the safety limit.

We do not wish to waste many words on the explosive hydrogen filled gas bags, because they could be filled with non-explosive helium-gas. This gas has a somewhat smaller lifting power.

It is the huge gasoline tanks that are the dirigible's most vulnerable point. For it must never be forgotten that an airship is a huge static electricity machine. The friction of the envelope against the air charges the entire dirigible with a high potential. In passing rapidly from a cold to a warm air stratum, or from a dry to a wet one, or *vice versa*, the electric charge often changes abruptly, and electric sparks begin to fly. Woe if there is a leak along the gasoline tanks or supply pipes. And as far as we can ascertain no protection against these stray electric sparks has been taken in the modern dirigible that it is worth while to speak of.

The present rigid dirigible is a failure. The right direction is in the production of a solid metallic skin—perhaps a double walled one—the interior containing no gas, but a vacuum, which is lighter for a given volume than hydrogen. Such a machine has recently been constructed by two Italians. We will have more to say about it presently.

H. GERNSBACK.

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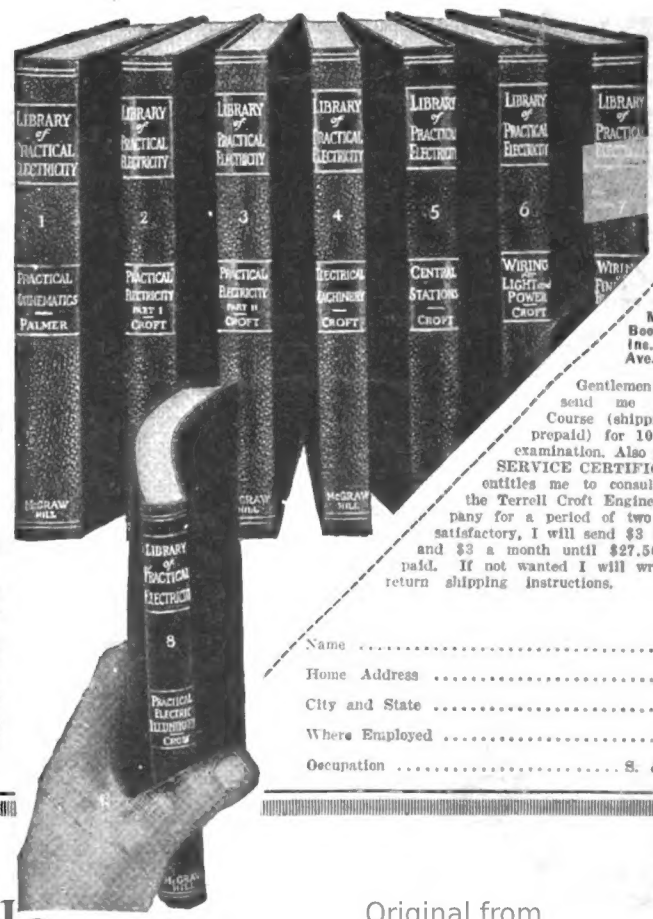

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Volume IX
Whole No. 102

Science and Invention

H. GERNSBACK, - EDITOR
H. WINFIELD SECOR, - ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D., - ASSOCIATE EDITOR

OCTOBER
1921
No. 6

An Octopus That Never Lived

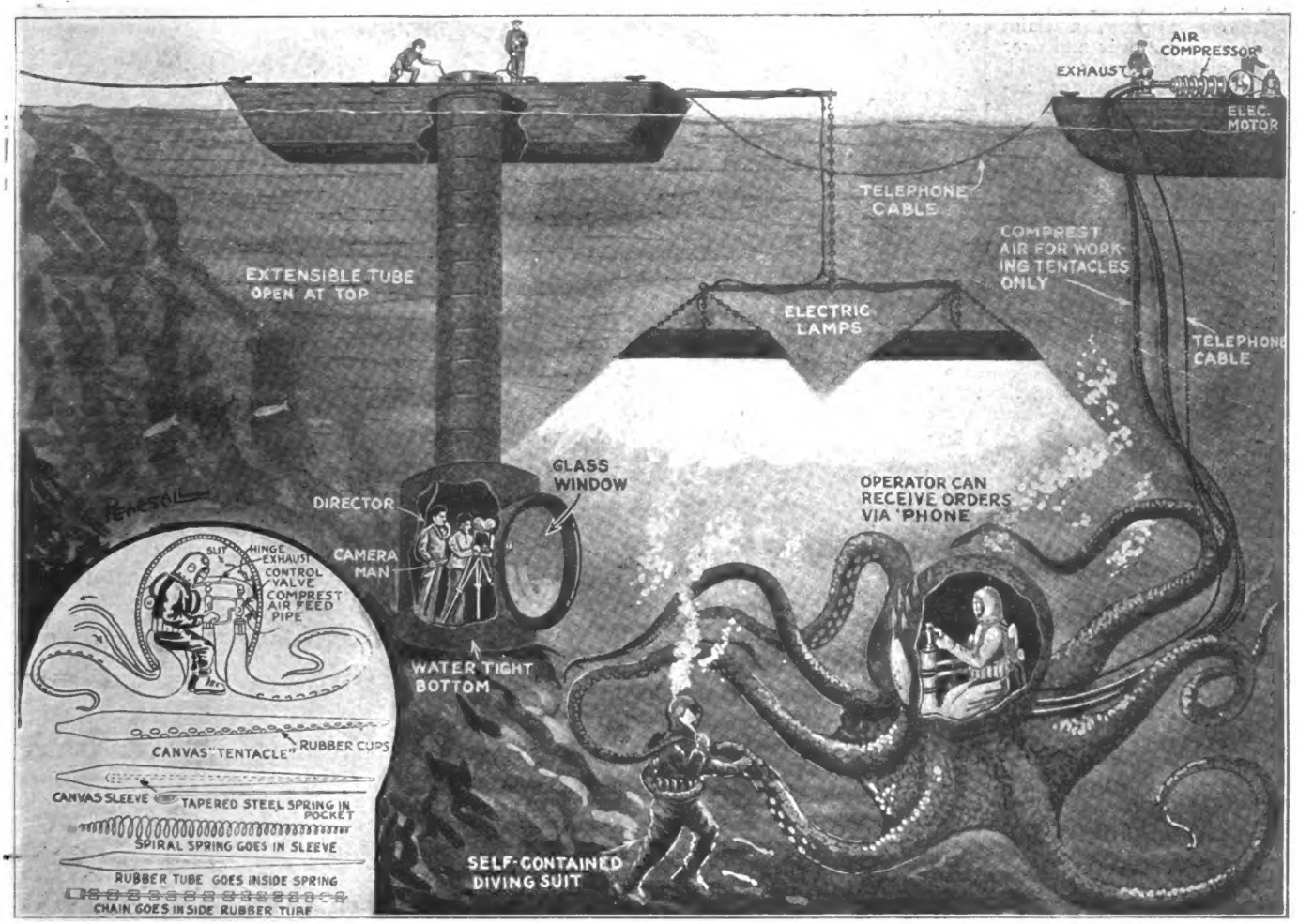
POSSIBLY you were fortunate enough to have witnest the famous motion picture taken under the sea, in which a man fights a battle with a terrifying octopus, or devil-fish. If you did see this picture, you undoubtedly were puzzled as to how this undersea battle was actually staged in photographing the scene. The interesting details of how the uncanny and lifelike movements of the long slashing tentacles of the octopus were produced, are given in a patent recently issued to John Ernest Williamson. The arrangement of the machinery used in producing this remarkable undersea picture, is shown clearly in the accompanying illustration.

To start with, the motion pictures were taken with an ordinary *movie* camera placed in a watertight compartment at the bottom of the tube shown in the picture. The compartment containing the movie camera, the photographer and the director, was left open to the air, and as the tube was watertight at the bottom and along its entire length, the men at the bottom of the tube received plenty of fresh air at all times. Electric light and telephone wires were led down into the photography room, orders being given by telephone when necessary to Mr. Octopus—who was personified by none other than a full-grown man, who had carefully studied the movements of this particular undersea cephalopod—so that, by varying the amount of comprest air forced into the hollow, flexible tentacles, very realistic movements of the latter were effected.

The man who sat inside the body of this made-to-order octopus was equipt with one of the new style self-contained diving suits, which are fitted with the necessary oxygen and other tanks, and carried on the back, so that no rubber tubes for supplying air, etc., were necessary so far as he was concerned. Two small sized rubber tubes were led from the body of this pseudo-octopus to the surface of the water, where one of the tubes connected with a motor-driven air compressor; while the other was simply secured to a length of pipe open to the atmosphere, so as to serve as an exhaust.

The central body shell of this awesome looking devil-fish was built in two parts hinged together, so that the operator could easily enter or leave it. Owing to the arrangement described, and by utilizing the self-contained diving suit, no air

(*Continued on page 571*)



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"In the Movies They Do It." What? Why Build Deep Sea Monsters to Order. This Monster Octopus Never Lived, Yet Thousands of Photoplay Fans Have Seen the Battle Between the Terror of the Deep and a Man, and Could Have Sworn That it Was a Real Honest-to-Goodness Octopus. Comprest Air, Admitted to or Released from the Canvas Tentacles, Caused Them to Curl Up In That Creepy Fashion That Makes You Shiver. Electric Lights Helped to Illuminate the Scene Under Water, While Telephone Orders Could be Given to the Man Inside the Octopus. The Photographer was Located in a Water-Tight Tube in the Manner Shown. A Self-Contained Diving Suit Was Worn by the Man in the Octopus.

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Can We Make Rain?

By PROF. T. O'CONOR SLOANE, Ph. D., LL.D.

FOR many years it has been maintained that rain followed or accompanied battles. Going back to the days of ancient Rome we find Pliny and Plutarch claiming that rain occurred after the battles of those days. It is hard to formulate any tangible cause for rain after a battle carried on without gun power. Some modern writers have even gone so far as to claim that the flight of missiles, such as showers of arrows, which were said to darken the heavens, of stones from slings, and perhaps also of javelins, so perturbed the lower atmosphere by their friction with the air, as to play a part in bringing on rain. This theory certainly seems too sublimated for belief, altho upholders of it can be found.

But coming to the days of villainous saltpeter, a claim has been made over and over again, and vigorously upheld, that the detonation of artillery has caused rain. In the days of Napoleon, the cannonade at the battle of Ligny is said to have brought on rain. This was immediately before the battle of Waterloo, and the rain is said to have held back the attack, and this postponement, it is claimed, gave Blücher with his Prussians a chance to come up, and turned the tide against Napoleon. In this theory there seems to be a touch of romance, such as Victor Hugo indulged in about the same battle.

At Solferino a rain is said to have poured down and favored the retreat of the Austrians.

During the Crimean War, it is mentioned that rain in France announced the battles of Inkermann and Sebastapol, of course not telling the Minister of War which side won. Other announcements of the same nature are described, all based on the theory that rain even at distant points is caused by cannonading.

It is claimed that the air may be ionized by the cannon, favoring the condensation of vapor into rain drops. It is even suggested that ionized air may be released from shell holes.

In Italy and France artillery firing has been seriously tried out for breaking up hail storms with little or no results. Many freak designs of anti-hail guns, with great flaring funnels, were devised and sold. The guns were supposed to be fired at the approaching hail-storm. In this country years ago, explosives were sent up in balloons and detonated at high levels in the effort to produce rain. Today there is an inclination in France to believe that cannonading at the front in the World War did produce rain, even at very distant points. Sudden rains without barometic change were chronicled and the science of meteorology seemed to be all upset during the months of the bombardment.

Displacement of cold air in the upper regions of the atmosphere may cause distant rains. The great eruption of Krakatoa affected an enormous area of the upper atmosphere.

Clouds accompany rain almost always. For the formation of a cloud, countless nuclei for the little vesicles of water are essential. Each vesicle has its core of a dust particle. If these vesicles of water meet a stratum of air charged with water vapor, each vesicle will condense water on its surface, form a drop, and rain will ensue. Fog vesicles are about 1/2500th inch in diameter and if they are descending, they move at about 7 inches a minute. The least updraft of air will, therefore, prevent their descent. Drops of light rain may be 1/50th inch in diameter, falling at the rate of 400 ft, a minute, while heavy rain will fall in drops about 1/16th to 1/8th inch in diameter, and will fall at the rate of 1,000 ft. a minute.

It is astonishing how little water forms a fog or a cloud. In 1,000 cu. ft. of either. there is but 1/150th ounce of water, but many millions of vesicles. If each vesicle condensed water from the air upon its surface so as to form a rain drop, a heavy rainfall would ensue. The theory then of the production of rain comes to this. The minute quantity of dust always present in the atmosphere, some of which may even be cosmic dust, forms nuclei for the formation of cloud and fog vesicles. If these vesicles meet a quantity of saturated air, they do their work as rain producers, but rain cannot be produced from a simple cloud nor from dry air. The combination of the cloud and the water-saturated air is essential.

THERE are few things that influence our activities, our moods, our general well being more than the weather. It is one of the great factors in our daily lives.

Naturally the thought to control the weather artificially has occurred to many minds since antiquity and the solution of this problem is one of the most baffling ones in science. We have endeavored in these pages to show what has been accomplished so far towards controlling the weather in general and altho not much that is positive has been realized, still we may say that there has been a good beginning.

—EDITOR.

Following out the lines of this theory, it will appear that there can be no fog and no cloud without dust. Without clouds, there can be no rain, but the water would all be deposited on the earth as dew by condensation, and precipitation would cease.

Some claim that dust in the air will has been proposed to effect, by using rockets and air-ships to distribute dust in the upper atmosphere.

convert fog to rain. This impossibility it

The amount of water required to saturate air is less as the temperature falls. Partially saturated air can be made supersaturated by cooling, and it has even been proposed to produce rain by releasing liquid air from balloons. In spite of the proverb, we know that figures do lie sometimes. It has been calculated on the figures of the operation of ice factories, that it would require 2,000 horse power for a day to produce one inch of rain over an acre-area. The tons of coal required for an area of 100 miles radius it is figured, would be about 150,000,000 for each inch of rain. Yet we find that the sun gives us heat enough to produce a 40-inch rainfall over the whole earth.

To produce an inch of rain over an area of 100 miles radius with air saturated at 60° F, and cooled to 50° F, a volume of air 2,000 ft. thick, 900 miles long, and 200 miles wide, would be required as the source of the water supply. It is evident that irrigation with our present knowledge, is enormously more economical than rain making, assuming that the latter could be done.

It has been proposed to combat fogs by blowing warm air into the mass, so that the air would take up the moisture as the temperature rose. Some good results have been obtained in this way. The great trouble in all these proposed treatments of air is the incredible volume that enters into the proposition. The mere size question makes the problem enormously more difficult. As there can be no clouds or fogs without dust, if the dust could be removed or precipitated as by static electricity, there would be a chance of disposing of the fog question at least. An English scientist proposed that lofty antennae be erected, and electricity discharged therefrom at a potential of one million volts or so, thus dissipating the fog. And a London fog often ties up traffic all day, the streets becoming dark as night.

There is no telling what may be done in the future. When Hertz astonished the world by producing a microscopic spark at a few feet distant from an electric discharge, anyone who had predicted the daily work of our wireless systems would have been pronounced a pure dreamer. Man has done so much in the last two decades, that it is entirely unsafe to say that he will not eventually control the weather, produce and arrest rain, and abolish fogs. The latter, the abolishing of fogs, is almost a life and death affair, for a foggy landing of an airplane may mean death.

Many efforts have been made to produce rain. A rain maker was paid at the rate of $2,000 an inch in Alberta, Can., and his efforts were followed by over four inches of rain, so that he collected $8,000.00. We illustrate a tank which he set up and which he filled with a mixture which he claimed "opened the heavens." This is reported from Medicine Hat, on the Canadian Pacific Railroad, and now Wisconsin has offered him $3,000.00 an inch for rain. If rain ever is scientifically produced, it will not have the ear-marks of mysticism.

ELECTRIFIED BALLOONS TO MAKE RAIN.

Several years ago considerable interest in scientific circles was aroused by the experiments carried out by Mr. J. G. Balsillie in Australia, and who was reputed to have had the backing of the Australian government, in his efforts to cause rain at will. Mr. Balsillie's plan for producing rain called for the sending up of a large number of captive balloons to a height of 6,000 or 7,000 ft. A metallic conductor carried a high voltage up to the balloons, which were coated or covered with a metal foil or other conductor, and in this way electricity was discharged into the atmosphere for a considerable distance all around the balloon. This system was thoroly illustrated and described in the May, 1916, issue of this journal, page 7, and some very good basic ideas on the atmospheric conditions necessary for the production of rain were there given.

The high potential discharge of electricity is a very fruitful source of large numbers of nuclei. An electric glow may be present in such a discharge, favorable to the production of nuclei, but there need be no spark discharge. A metallic source charged at high electric potential is thus a good source of nuclei. Moreover, as Dr.

(*Continued on page* 577)

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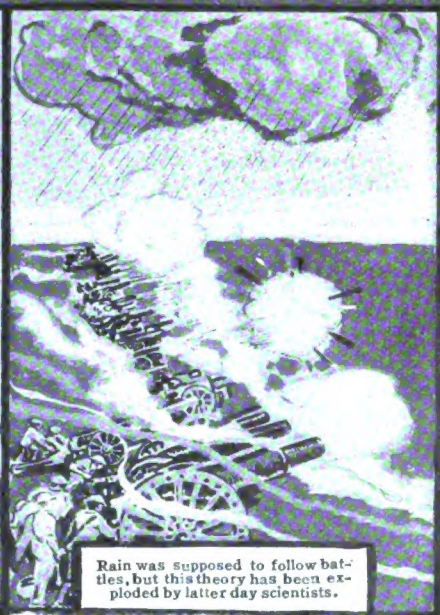
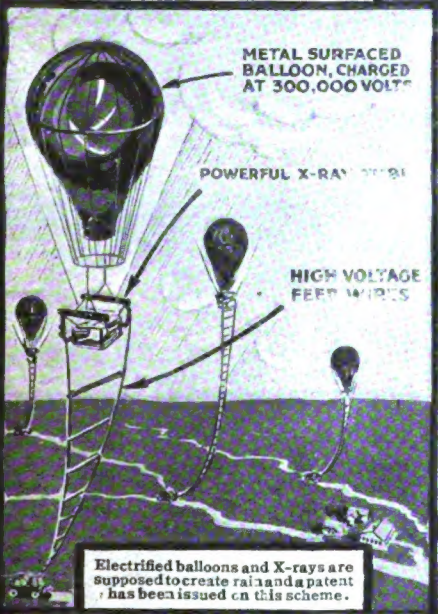
CAN WE MAKE RAIN?

The Hatfield Rain-Maker. It is filled with chemicals, ignited, and rain is supposed to fall plentifully.

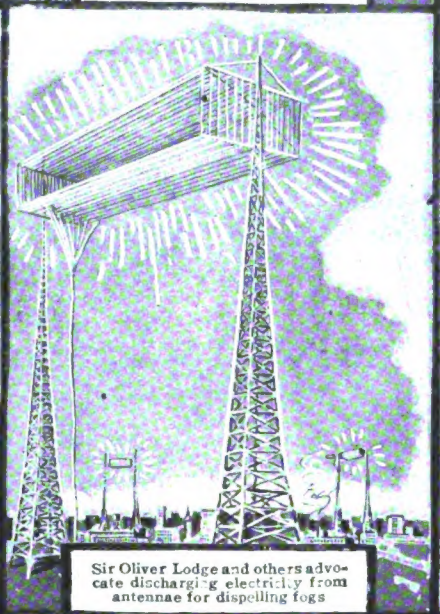


Rain was supposed to follow battles, but this theory has been exploded by latter day scientists.

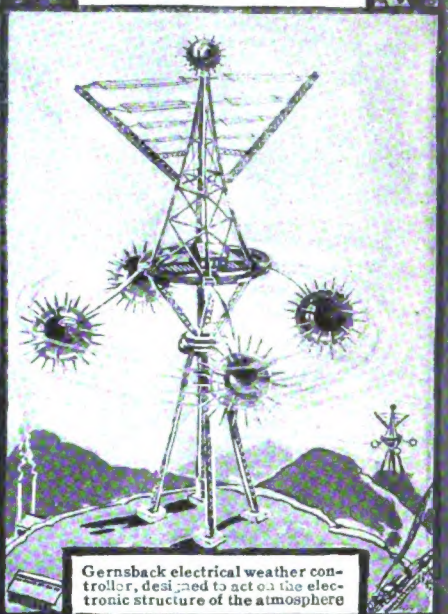
In the French vineyard districts, they still use hail guns to disperse hailstorms, but their efficacy is nil.



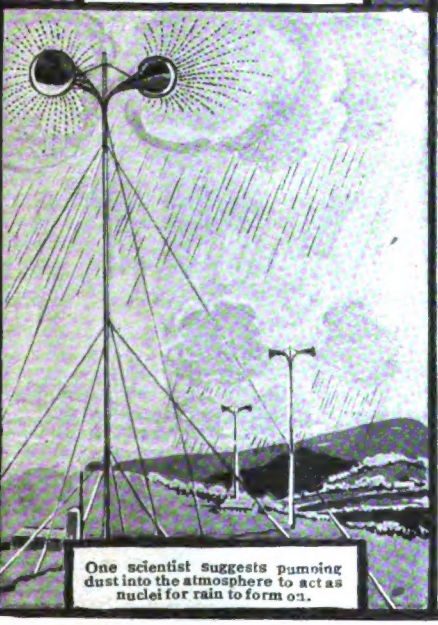
Electrified balloons and X-rays are supposed to create rain and a patent has been issued on this scheme.



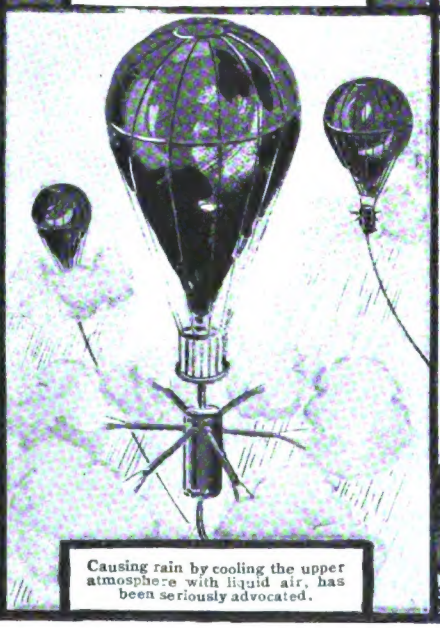
Sir Oliver Lodge and others advocate discharging electricity from antennae for dispelling fogs



Gernsback electrical weather controller, designed to act on the electronic structure of the atmosphere



One scientist suggests pumping dust into the atmosphere to act as nuclei for rain to form on.



Causing rain by cooling the upper atmosphere with liquid air, has been seriously advocated.

Warm air has been tried successfully, it is said, in annihilating fogs.

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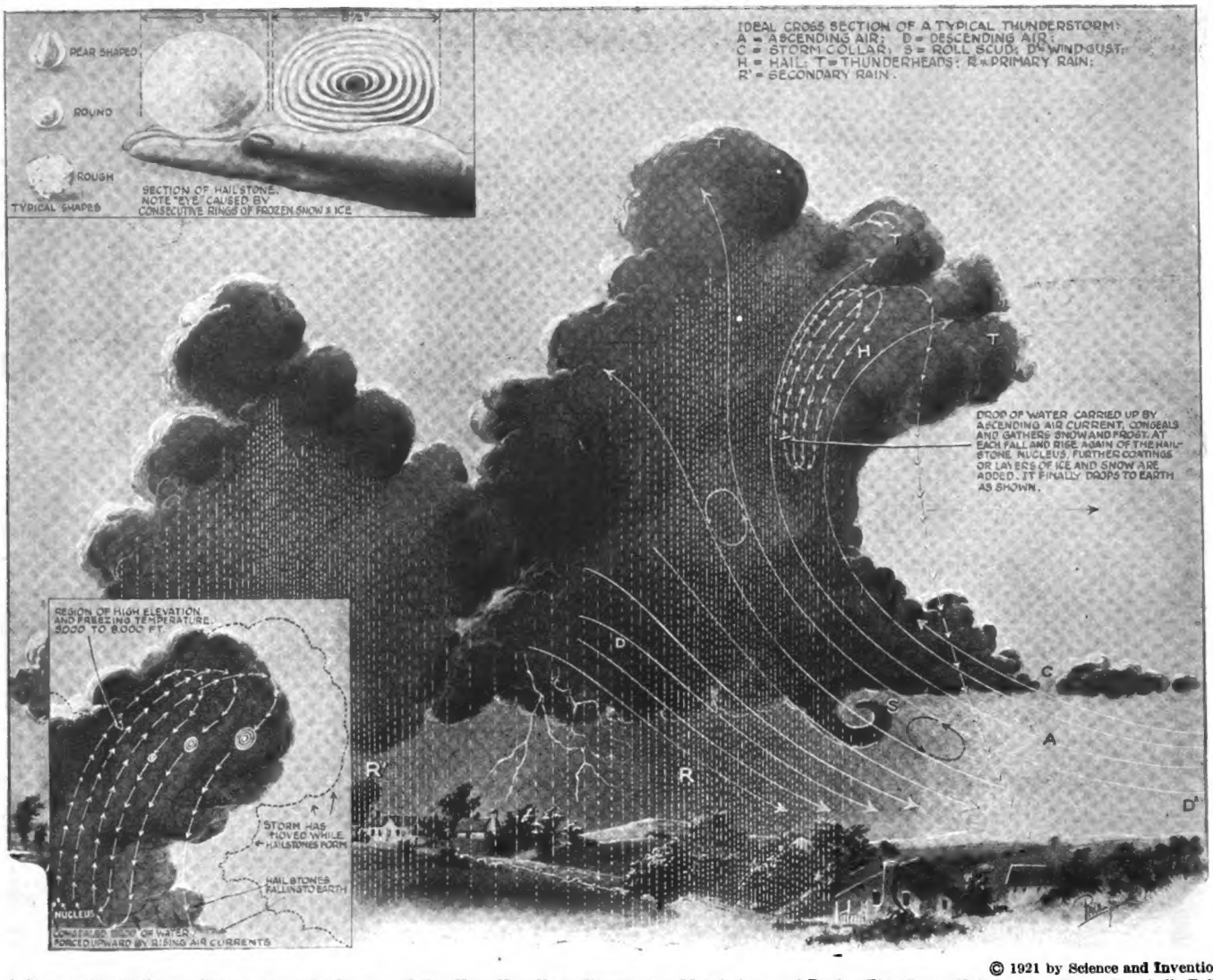
PEAR SHAPED
ROUND
ROUGH
TYPICAL SHAPES
SECTION OF HAILSTONE, NOTE "EYE" CAUSED BY CONSECUTIVE RINGS OF FROZEN SNOW & ICE
IDEAL CROSS SECTION OF A TYPICAL THUNDERSTORM:
A = ASCENDING AIR; D = DESCENDING AIR;
C = STORM COLLAR; S = ROLL SCUD; D' = WIND GUST;
H = HAIL; T = THUNDERHEADS; R = PRIMARY RAIN;
R' = SECONDARY RAIN.
DROP OF WATER CARRIED UP BY ASCENDING AIR CURRENT, CONGEALS AND GATHERS SNOW AND FROST. AT EACH FALL AND RISE AGAIN OF THE HAILSTONE NUCLEUS, FURTHER COATINGS OR LAYERS OF ICE AND SNOW ARE ADDED. IT FINALLY DROPS TO EARTH AS SHOWN.
REGION OF HIGH ELEVATION AND FREEZING TEMPERATURE. 5000 TO 8000 FT.
STORM HAS MOVED WHILE HAILSTONES FORM
HAILSTONES FALLING TO EARTH
NUCLEUS
CONGEALED DROP OF WATER FORCED UPWARD BY RISING AIR CURRENTS

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A Remarkable Hailstorm Passed Along the Ramapo Valley Near New York City About a Month Ago, and During This Storm Hailstones as Big as Baseballs Fell. Conservative Measurements of the Thousands of Hailstones That Fell Gives 3½" Average Diameter, as Shown in the Upper Left Hand Illustration, but Much Larger Ones Also Fell. The Central View Shows the Formation of a Thunderstorm from Which Hail Falls, the Hail Being Formed in the Upper Cloud Layers at "H," and Not in the Region of the Roll-Scud "S," as Previously Believed, According to the Latest Scientific Understanding of the Subject. The Reason Why We Hear Two Periods of Maximum Rainfall During a Thunderstorm, and Often Mistake This for a Thunder-storm Returning, Is Made Clear by the Positions Shown Where Two Maximum Rainfalls Occur—"R" Primary, and "R-1," Secondary Rain. Lower Left Insert Shows How a Nucleus of a Hailstone Is Formed From a Congealed Drop of Water Carried Upward by the Rising Air Currents "A" as This Congealed Droplet Rises to the Colder Cloud Layers, It Is Frozen, and After Falling and Rising Several Times, Successive Layers of Snow and Ice Are Formed Around the Nucleus and Eventually It Falls to Earth, Looking Like the Mysterious Object Shown in the Upper Left View.

What Is A Hailstone?

AN exceptionally severe fall of hailstones, some of them as big as a man's fist, accompanied a thunder-storm which moved along the Ramapo Valley on July 31st, doing a great deal of damage to buildings, live stock and crops. H. W. Secor, of the editorial staff of this journal, who resides near Suffern, N. Y., which is about 32 miles from New York City, had the opportunity of witnessing this unusual fall of hailstones which occurred in the first part of the thunder-storm at about 3.00 o'clock in the afternoon and also measured a number of the hailstones; many of these had a diameter of from 2½" up to 3½", that is larger than a baseball, or about the size of an orange. The hailstones greatly resembled snowballs which have been soaked with water and then frozen; in some cases they pierced the shingle roofs of houses and of course broke hundreds of windows. One green-house had practically every pane of glass in it shattered, and automobile tops were punctured as easily by these hailstones as if they had been made of paper. Many animals were severely cut by them and several people driving automobiles were injured so that they, in at least one case, lost control of the car, the hailstones falling naturally with a very high velocity. Some of the smaller and solidly frozen hail stones, about 1" in diameter, made holes in the ground and buried themselves from 6 to 12 inches deep.

The upper left insert gives a clear idea as to the gigantic size of the hailstones which fell in Suffern and other adjacent towns along the Ramapo Valley. There were larger stones or conglomerate masses, possibly composed of several hailstones frozen together, which appeared to measure 5 to 6 inches in diameter, but which broke up on hitting the ground or rocks, roofs, etc., so that they could not be measured. The shape of the hailstones varied considerably, as shown in Fig. 1, some of them being almost perfectly round like a musket ball, while others were irregular in shape; some as large as baseballs were more pear shaped or else oval, and had several rough jagged horns protruding at one side, possibly due to their outer coating of ice or snow, having partially melted on their rapid descent from the clouds and the tendency of the descending mass to assume a stream-line shape. When some of the larger hailstones happened to break in half on landing, a very peculiar layer formation or structure was at once noted. This is shown also in Fig. 1. At the center appeared the nucleus of solid black ice and in succeeding rings around this nucleus were frozen alternate layers of snow-ice and clear ice. So much for the hailstones themselves, but what interests us most, undoubtedly, is as to how these mysterious missiles from the sky form and build up, and they certainly do build up in successive layers, as seems logically certain from their structure, as shown in Fig. 1.

HOW HAIL STONES ARE FORMED

Several different theories have been advanced as to how hailstones actually form, but the one usually accepted by meteorologists is as follows: A drop of water in the lower part of the thunder-cloud is caught by an uprushing stream of air, and carried upward until it reaches a higher zone of cold air, where it congeals or becomes partially frozen. As the drop of water ascends still farther, it reaches an altitude of possibly 5,000 to 8,000 feet, where the drop of water becomes frozen

(*Continued on page* 552)

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Sawing Thru Houses and Streets

By JACQUES BOYER

IN Paris it recently became necessary to put a subterranean gallery across the Pont Neuf. This translated means the New Bridge; in reality it is about the oldest bridge crossing the river Seine. The gallery was to be in the neighborhood of 7 feet high, and upwards of 4 feet wide. A part of the bridge was of such soft material that the gallery could be excavated, but a portion of it was virtually monolithic, being composed of blocks of stone set in concrete.

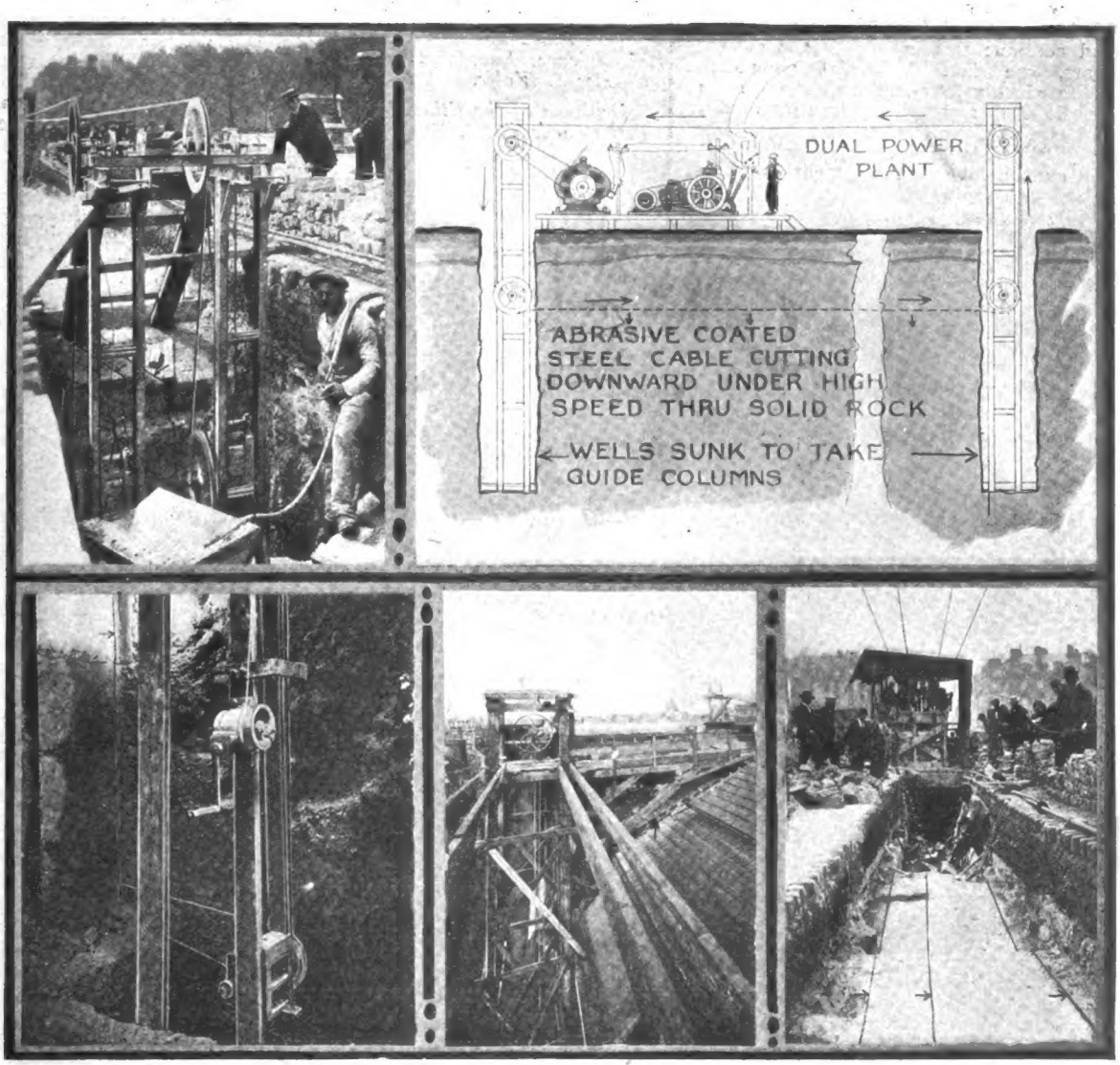
The method of attack was the following: At the points marking the ends of the proposed trench, holes were sunk, like little wells, down to the level of the bottom of the trench. In these holes were mounted frames with vertical runways on which carriages traveled. These carriages had cable wheels and between the wheels, extending the entire length of the trench, a wire cable was stretched. This cable was endless. At first considerable trouble was experienced in joining the ends; brazing and the like would not stand the wear and strain. It was only when a proper long splice was put in, sailor-fashion, that the junction was obtained which stood up under the work.

The idea was to cut long, narrow grooves, right down thru the stone. The cable was about one-third of an inch in diameter. To make it cut, it was fed with water and an abrasive. By motors it was kept moving constantly at a speed of about 20 feet a second. The circuit of the cable was nearly 1,500 feet. One great reason for using this cable was the danger of doing any operation on the ancient bridge which would impair its solidity. The bottom of the trench was to be carried down to within some 20 inches of the intrados of the arch at the keystone. Blasting was out of the question and even wedging, hammering and prying out the material was considered dangerous. But here without the least disturbance a cut was carried right down to the bottom of the trench, giving a well defined, perfectly straight side wall on each side. The power required was about 40 H. P. Each cut was about 160 feet long and four parallel cuts were made for each trench.

Another achievement in this order, which we also illustrate, was the cutting of what we might call the party wall of two houses in Paris. The idea was to isolate one house from the other, as it was proposed to introduce a lot of electric machinery in one of the buildings, namely, rotary transformers, whose vibrations would be communicated to the neighboring house. Here again the endless cable was used and the operation was most successful, the two buildings being made quite independent of each other. The electric company's building was a steel frame structure, and the division of the two buildings was effected without impairing the solidity of either one of them.

It would be unsafe in such cases as this to attempt to cut out by hand any of the party-wall. Merely to get room to work the hand tools would involve practical destruction of the party-wall. But the cable system puts a cut about half an inch wide thru the wall isolating the buildings effectually and leaving plenty of material in the walls.

(*Continued on page 558*)


DUAL POWER PLANT
ABRASIVE COATED STEEL CABLE CUTTING DOWNWARD UNDER HIGH SPEED THRU SOLID ROCK
WELLS SUNK TO TAKE GUIDE COLUMNS

Actually Sawing Thru Houses and Streets — This Operation was Recently Carried Out in Paris, France — in the Manner Made Apparent from the Accompanying Photographs and Diagrams. An Endless Steel Cable was Arranged Over a Section of Pulleys, and so Connected to a Driving Motor or Engine that the Cable Could be Driven at High Speed. This Cable was Charged with Abrasives, and as the Material was Cut, the Position of the Cable Wheels was Changed, so That the Cable was Carried Down Farther and Farther, the Cutting Operation Progressing with the Feeding Movement Imparted to the Cable. Finally a Steel Frame Building was Divided in Two Parts by a Cable Cutting Operation, Somewhat Similar to That Used in Cutting the Sections of the Bridge Roadway. Cuts Marked by Arrows.

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Subways of Tomorrow

REGINALD PELHAM BOLTON, a well known engineer of New York City, recently created quite a furore in rapid transit engineering circles, by making a number of radical and bold suggestions as to what the subway system of to-morrow will resolve itself into.

"To begin with," said Mr. Bolton to the writer, "we are already beginning to feel the intense pressure of the ever-growing population and transit problems of New York City, and of course the same line of reasoning holds good for other American cities, where the population and housing is becoming congested. It is very evident, when we stop to think about it for a moment, that the subways, which we have today, are not going to solve our problems when the morrow arrives. It is a little difficult perhaps to conjecture as to what New York City, and this applies to all large cities in general, is going to look like 20 or 40 years hence. If we are to fulfill our duties properly, we should design our subways to provide for the future millions of people who will settle in these districts.

"Twenty-five million," said Mr. Bolton, "is the logical estimate of the population which will call greater New York City *home* in the year 2,000, but 79 years beyond our time. Of course that is quite a long way off, but when we plot the curve of the growth of New York's population and continue this curve for the coming years, we find 11,000,000 population indicated only 29 years hence, or in the year 1950, this great American metropolis and sea-port will then have at least 11,000,000 souls in its environs, while 1975 will undoubtedly see the population, based on the past rapid growth of this city, rise to 16½ millions; even now, if we consider some of the districts adjacent to Manhattan and Brooklyn, we practically have a population of nearly 8,000,000 souls."

At the present time, as Mr. Bolton pointed out, we have the anomalous condition of one of the world's greatest cities growing outward principally in but one direction—toward and out Brooklyn way—so we find that thousands of New Yorkers, due to transit conditions prevailing at present and in the past, have failed to realize what a wonderful stretch of country lies to the west across the Hudson River, in New Jersey.

The greater New York of 25 to 40 years from now will cover a vast area like a great circle, with a diameter of at least 50 miles. Let us imagine that the center of this circular area is located at the Grand Central station on Manhattan Island, or at the intersection of 42nd Street and any one of the avenues which cross it. The man or woman who works in Manhattan will not be able to find a home on this small island at that time, and they can hardly do so now, even when they are willing to pay an exorbitant rental; so they will dash north and south, east and west, from their respective offices and factories, toward the great central high speed subway station located probably in the neighborhood of the Grand Central or Pennsylvania Railroad terminals.

This giant station will eclipse either of the present two famous railroad terminals in size; escalators or moving stairways will carry the people down to a lower floor, from which a dozen or more high speed elevators carrying from 50 to 100 people each, will descend to a depth of 400 to 600 feet, where the commuters will board the high speed subterranean railroad trains, which will hurl them homeward at a speed of 60 to 70 miles an hour or more. The electric elevators could travel at a speed of 700 feet per minute. Stations along the lines of this high speed direct-route subway system of tomorrow will be located from five to ten miles apart, from which points the suburban dwellers will pursue their way to their homes via surface lines, by motor or via sub-surface subways.

The wonderful simplicity and flexibility of Mr. Bolton's idea lies in the fact that with such a centralized subway system running at great depths underground, the routes may be made in practically straight lines, radiating like the spokes of a wheel, as the map shows. The tubes themselves, Mr. Bolton suggested, can be made entirely of concrete, without any iron inner linings, like those used on the Hudson Tunnels. His basis for this belief is founded on the remarkable Catskill water aqueduct which runs for nearly 100 miles far under the earth. The details of this huge concrete tube and how it was built are described in detail in the Proceedings of the Institute of Civil Engineers, which can be consulted at any library and prove interesting indeed.

Feature November Articles

Flying Railroads of Tomorrow—Giant Electrically Propelled Cars.

Earthquakes Made to Order—How they do it in the movies. Specially illustrated and described.

Sand and Water Spouts—How Formed. With pictures.

Electric "Wash-out" Signal for Railroads.

New Subterranean Tunneling Machine. By C. S. Corrigan, C.E.

"The Filled Tooth"—A mystery tale of Science, Love and a Girl. By Charles S. Wolfe.

Denizens of the Ether. By Harold F. Richards, Ph.D.

How to Make and Use a Macro-photographic Camera. By Dr. Ernest Bade.

Our Glands—Their Tremendous Importance to Our Health. By William M. Butterfield.

Ultra-Violet Light—Some practical applications of these little-known rays. By Dr. T. O'Conor Sloane, Ph.D., LL.D.

A Short Wave Regenerative Set—A compact, simple and efficient vacuum tube receiving set. By William H. Grace, Jr.

How to Make a Model Theater—Well illustrated with actual photos.

The trains, which will run in these subways, will have many innovations. "Why break up their stream-line surface or contour by placing glass windows in them; make them window-less, there is nothing to see except the smooth wall of the tube," said Mr. Bolton. The cross-sectional shape of the cars should be round and not irregular, as at present; the nose on the forward car should be made of hyperbolic form so as to cut the air more efficiently. Ventilation thru these deep underground subways will be effected by the piston-like action of the high speed train as it rushes along. The construction air shafts can be left in place, at say ¼ to ½ mile intervals, and emergency elevators may very well be placed in these shafts; finally they will serve to help solve the ventilation problem. Consider a train moving along between two of these air shafts; it will suck air down thru the shaft it has just past, and force air ahead of it and up thru the shaft ahead of it. By making the train of circular cross-section so as to more properly adapt it to the circular shape of the tube, it will approximate the true piston action, such as we have in the air-rifle, or engine cylinder. Suitable ventilation holes or openings are to be arranged in the front ends of the train, and along the sides, so that plenty of air will pass thru the train; sufficient space is left between the steel shell of the car and the tube wall itself, so that some air can pass by, in order that the train will not encounter too great a head resistance.

"The trains should be arranged to pass out along one tube and return thru another entirely separate tube," said Mr. Bolton, "and the tubes may run close to and parallel to each other, but where it might seem desirable for various reasons, the return tube may be situated some distance from the outgoing tube." Mr. Bolton is a firm believer in large elevators and suggested that unless the conditions warranted it, the high speed subway need not come to the surface even at the end of a 40 or 50 mile run, but that giant electric elevators could be readily built to lower the rolling stock, that is the cars themselves, down to the tube level. The length of a 10 car train in the New York subway at present is about 440 ft. Said Mr. Bolton, "Why not have these subterranean high speed railways of tomorrow run in practically straight lines and equipt with long single car trains several hundred feet in length?" If we follow this design there will be a considerable gain in the efficiency of operation, for where various sections or cars in a train are continually swaying, there is an appreciable loss in energy, owing to the increased head resistance encountered, especially at high speed, due to the overhanging of the front surfaces of these cars, as they swing into and out of line with the other cars; and further, there is a loss due to the pocketing of air at the junctures between the cars, which is a factor worth considering when speaking of such high speed subways. "It is one thing to specify high speed, and another thing to obtain it," said Mr. Bolton. "The New York subways are supposed to attain a speed of 40 miles per hour for express trains, but they have never reached their contract stipulation, and the express trains realize an average speed of but 24 miles an hour, from station to station."

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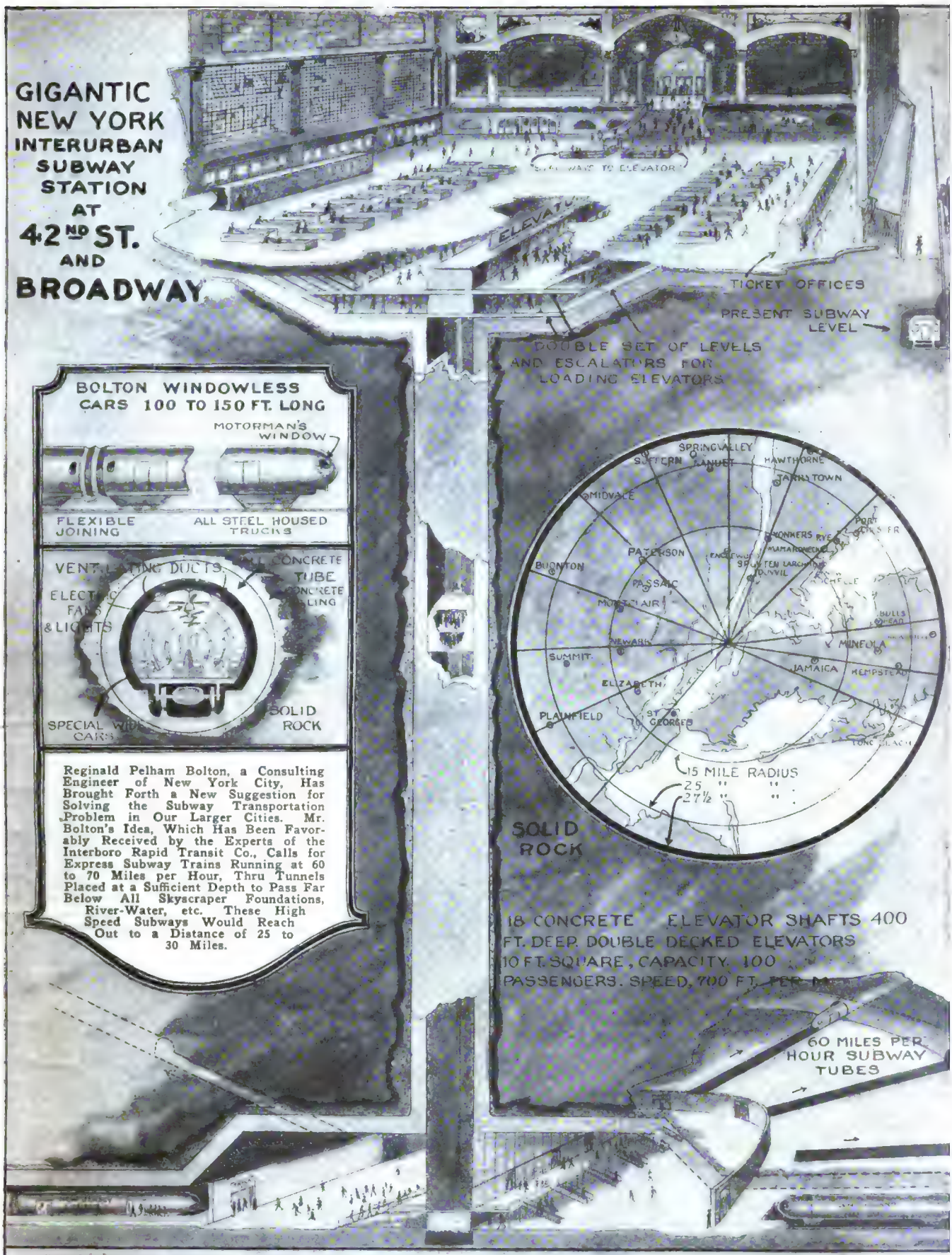
GIGANTIC NEW YORK INTERURBAN SUBWAY STATION AT 42ND ST. AND BROADWAY


TICKET OFFICES
PRESENT SUBWAY LEVEL
DOUBLE SET OF LEVELS AND ESCALATORS FOR LOADING ELEVATORS
BOLTON WINDOWLESS CARS 100 TO 150 FT. LONG
MOTORMAN'S WINDOW
FLEXIBLE JOINING
ALL STEEL HOUSED TRUCKS
VENTILATING DUCTS
CONCRETE TUBE
ELECTRIC FANS & LIGHTS
SPECIAL WIDE CARS
SOLID ROCK
Reginald Pelham Bolton, a Consulting Engineer of New York City, Has Brought Forth a New Suggestion for Solving the Subway Transportation Problem in Our Larger Cities. Mr. Bolton's Idea, Which Has Been Favorably Received by the Experts of the Interboro Rapid Transit Co., Calls for Express Subway Trains Running at 60 to 70 Miles per Hour, Thru Tunnels Placed at a Sufficient Depth to Pass Far Below All Skyscraper Foundations, River-Water, etc. These High Speed Subways Would Reach Out to a Distance of 25 to 30 Miles.
SPRINGVALLEY
SUFFERN
NANUET
HAWTHORNE
MIDVALE
PORT CHESTER
YONKERS
PATERSON
BUONTON
PASSAIC
MONTCLAIR
NEWARK
SUMMIT
ELIZABETH
PLAINFIELD
ST GEORGES
MINEOLA
JAMAICA
HEMPSTEAD
LONG BEACH
15 MILE RADIUS
25 " "
27½ " "
SOLID ROCK
18 CONCRETE ELEVATOR SHAFTS 400 FT. DEEP. DOUBLE DECKED ELEVATORS 10 FT. SQUARE, CAPACITY 100 PASSENGERS. SPEED, 700 FT. PER MIN.
60 MILES PER HOUR SUBWAY TUBES
NEWARK
JERSEY CITY
PROPOSED HUDSON RIVER BRIDGE
NEW YORK CITY
BROOKLYN BRIDGE EAST RIVER
BROOKLYN
PRESENT SUBWAY
STATIONS 5 TO 10 MILES APART
NEW SUBWAY
LARGE UNDERGROUND CENTRAL SUBWAY STATION
25 TO 30 MILE RADIUS

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Drawn by E. M. Stevens

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Dotted Line Shows 260-ft. Path Followed by X-Rays in One of the Experiments. X-Ray Photo Obtained at This Distance From Tube Shown Above, Where We See a Skull, a Crab Shell, and a Bottle Containing a Copper Sulfate Solution.

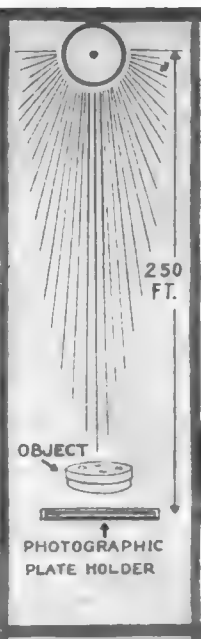


Diagram at Center Shows Arrangement of Coolidge X-Ray Tube, Object X-Rayed, and Photographic Plate Holder. The X-Ray Photo Above was Taken With a One-Hour Exposure at a Distance of 130 Ft. From the Coolidge Tube, the Objects X-Rayed Being Several Bones Taken From the Doctor's Specimen Cabinet. At Center—Vertebral Column; at Right—Femur Bone.

Long Distance X-Rays

M. G. CONTREMOULINS, a distinguished French scientist, having in his laboratory a number of X-ray installations which are used simultaneously, has investigated the possibility of shielding patients and operators from their evil effects. He describes three experiments showing that rays, which have made their way thru the ceilings of city habitations, while they may not affect the skin, are very dangerous for the glands of secretion of the dwellers in those houses.

While a six millimeter thickness of lead protects from the X-rays used in radioscopy and radiography, the radiations applied for therapeutic purposes, need further study. We quote from the conclusions he has reached. In the case of the intensities needed, for intensive therapeutic treatment of cancer, X-rays from a 25 centimeter spark excitation of the Coolidge tube, may be applied to the patient for twelve to fifteen consecutive hours, and in Germany a 120 centimeter spark excitation for five consecutive hours. In these cases the radiation has such penetration, that it may be considered almost as powerful as the radium spectrum. These sources of radiant energy cannot be placed in the midst of a city population, without the inhabitants incurring grave risks, and protective measures are urgently needed. M. Contremoulins presented to the Academy of Science superb teleradiographs, obtained at 40 to 80 meters distant (128 ft., and 256 feet), with a Coolidge tube operated by a 17 centimeter spark. These radiographs were of surprising definition and contrast. The author emphasizes the fact, that at 40 meters distance, a linen compress gives a good image, and he draws the conclusion, that the rays at this distance are capable of biologic action, i. e., action on living cell tissue. The same applies to a print obtained at twice the distance.

As regards the supposed protection of ordinary walls, the author obtained photographs at a distance of 15 meters on the other side of a thick wall (50 centimeters) of brick and stone. Four hours was a complete exposure. It is evident that these results obtained with modern intensities and densities of radiation, representing the most modern effects used in therapeutic practise, fully justify the author's warnings. Especially is this held to apply to France, where they are on the point of utilizing 200,000 volts potential in radio-therapeutic work. M. Contremoulins wishes a committee appointed by the Academy of Sciences to investigate the problem.

The recent death of Dr. Ironside Bruce, a well-known English specialist in X-ray works, leads the editor of the Lancet (London) once more to call attention to the danger of using these rays for long periods:

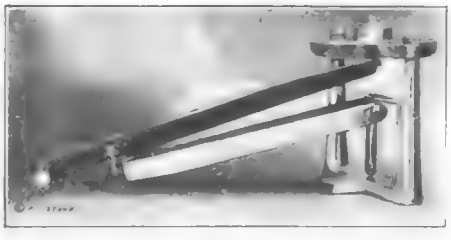
"It can only be surmised that during the course of his radiological work in alleviating the suffering of others Dr. Bruce received *fractional doses* of radiation, the effects of which manifested themselves with startling suddenness, for he died after only a brief illness. Such an event may cause apprehension among radiologists generally. The danger attending the use of X-rays are only now being fully revealed, and it is recognized that these fall into two categories—the superficial damage to the skin caused by the softer types of X-ray resulting in dermatitis, or still graver conditions; and the damage to the deeper structures, including the blood-forming organs, caused by the more penetrating types of X-ray and the gamma rays from radio-active substances."

Dr. Ivan I. Manoukhin has been studying the effects of X-rays on the body at large and not upon the growths to which they are directly applied. He has come to the conclusion that exposure of the spleen to X-rays causes it to set free into the blood certain solvents of the white corpuscles. Recent observations by Dr. J. C. Mottram show that repeated small doses of X-rays result in a serious diminution of the number of both white and red corpuscles. In extreme cases this results in pernicious anaemia.

A New Tone Arm for Phonographs

Mr. Clinton B. Repp, of New Jersey, claims to have perfected a new invention which produces entirely different and new interpretation of phonograph music. This invention is based on the idea of conveying tone vibrations thru solid wood and string instead of the hollow metal tone arm used in the present-day phonograph, thus eliminating the metallic harsh tone from instrumental music and the nasal tone from vocal music.

He has constructed a solid wood arm of the same wood used in the making of violins and aged by a special patented process which gives it the appearance of a fine piece of turtle ebony. This arm carries the vibration to the patented sound-box, which, is stationary, being connected to the center of the disc in the sound box by a linen string. This carries out the inventor's idea of the combination of wood and string.



The Latest Idea in Phonograph Reproducing Arms, Consisting of a Wooden Bar Delicately Pivoted, the Music Being Transmitted by the Wooden Bar to the Diafram at the Top of the Standard, to Which the Sound Amplifying Chamber is Connected.

This arm uses the ordinary type of steel needle which rests at a very low angle, developing an easy drag over the record and very materially lengthening the life of the record and reducing the surface noise. Furthermore, it plays all types of records, necessitating no mechanical change, but only the hooking or unhooking of the cord from the hook on the diafram.

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Renewing Your Blood

By H. W. SECOR and J. H. KRAUS

FIFTY, yes even thirty years ago, physicians used to treat their patients mostly by guess-work—professional guess-work if you please—but with all their knowledge of *symptoms*, they frequently did not know just what was the matter with their patients, particularly the condition of the blood. To-day every physician knows that in the case of many ailments he must have a chemical analysis made of the patient's blood before he can prescribe the proper treatment. Especially is this true where a person is suffering from some skin disease of which there are about 150 in 9 classes. Many of these skin diseases,

Purifying the Blood by Removal from Body and Treating it Electro-Chemically

and these are: First, by administering internal medicines in the form of draughts swallowed by the patient, which thus act on the blood indirectly thru the walls of the intestines, while the second method involves the injection of the medicine or serum directly into the blood stream by means of a hypodermic syringe. In just to mention this one branch of pathology, are due to the improper chemical composition of the blood; for example, the blood may contain too much uric acid, or perhaps an overpercentage of sugar, et cetera.

There are two principal methods in use at the present time for correcting improper chemical conditions in the blood, and also for destroying disease germs (in the blood)

Europe, and in other parts of the world outside of the United States, it is much more common to administer medicines intravenously or directly into the blood stream, and this technique is very advantageous for two reasons. In the first place, the medicine acts many times quicker and much more powerfully than when taken into the stomach; and, again, the patient is not liable to suffer by any impairment of the digestive processes, caused by taking powerful doses into the stomach.

In presenting the idea here illustrated and described, for purifying the blood by washing or treating it chemically and electrically, the authors have endeavored to substantiate their arguments by careful analysis of the various problems involved and also by direct experiments. Briefly explained, the *modus operandi* consists in extracting the blood from the body, either wholly or in part, and purifying the blood chemically or otherwise; then re-pumping this blood back into the body. The first method, which was tried out experimentally, but which now has been abandoned, was to extract all of the blood from the body, and as this was done the veins and arteries were kept dilated or filled with a substitute solution, such as saline (salt water), or Locke's solution, the pressure in the veins being kept approximately constant by checking with a blood pressure gage se-

(*Continued on page* 559)

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If This Method of Purifying the Blood Were Used in Our Hospitals, and Worked Up to the Final Point of Perfection, Many of the Diseases so Prevalent Today Could be Removed from the System. The Blood from the Patient Passes Thru Electrically Heated Apparatus. In the First One (A) We Could Administer Various Antitoxins and Serums, Such as Pollen Antigen for Hay Fever, etc. A Food Can be Inserted in the Second Dropper, Such as a 5% Glucose Solution and Saline or Anticoagulant in the Third Dropper. An Animal Membrane Divides This Chamber in Half so That, by Osmotic Action, Urea Can be Filtered from the Blood. In the B Chamber Any Other Nutriment or Medicant Could be Used Such as, Arsphenamine (Neosalvarsan). And in the C Chamber the Blood Is Acted Upon by Properly Regulated Ultra-Violet Rays Which Will Kill All Other Bacilli. The Pump at D Will Assist the External Circulation and at E We Have the Batteries. The Heat in Each of the Chambers Should be Kept at as Near Body Temperature as Is Possible, Unless We May Find It Necessary to Heat the Blood to a Higher Degree and Cool It Again to the Proper Temperature; in This Manner Killing Some of the Bacteria. All Operations Must be Carefully Watched and Regulated. The Patient Is Not Placed Under Anesthesia During the Process, Local Anesthesia Sufficing for the Minor Incisions Over the Median Basilic Vein.

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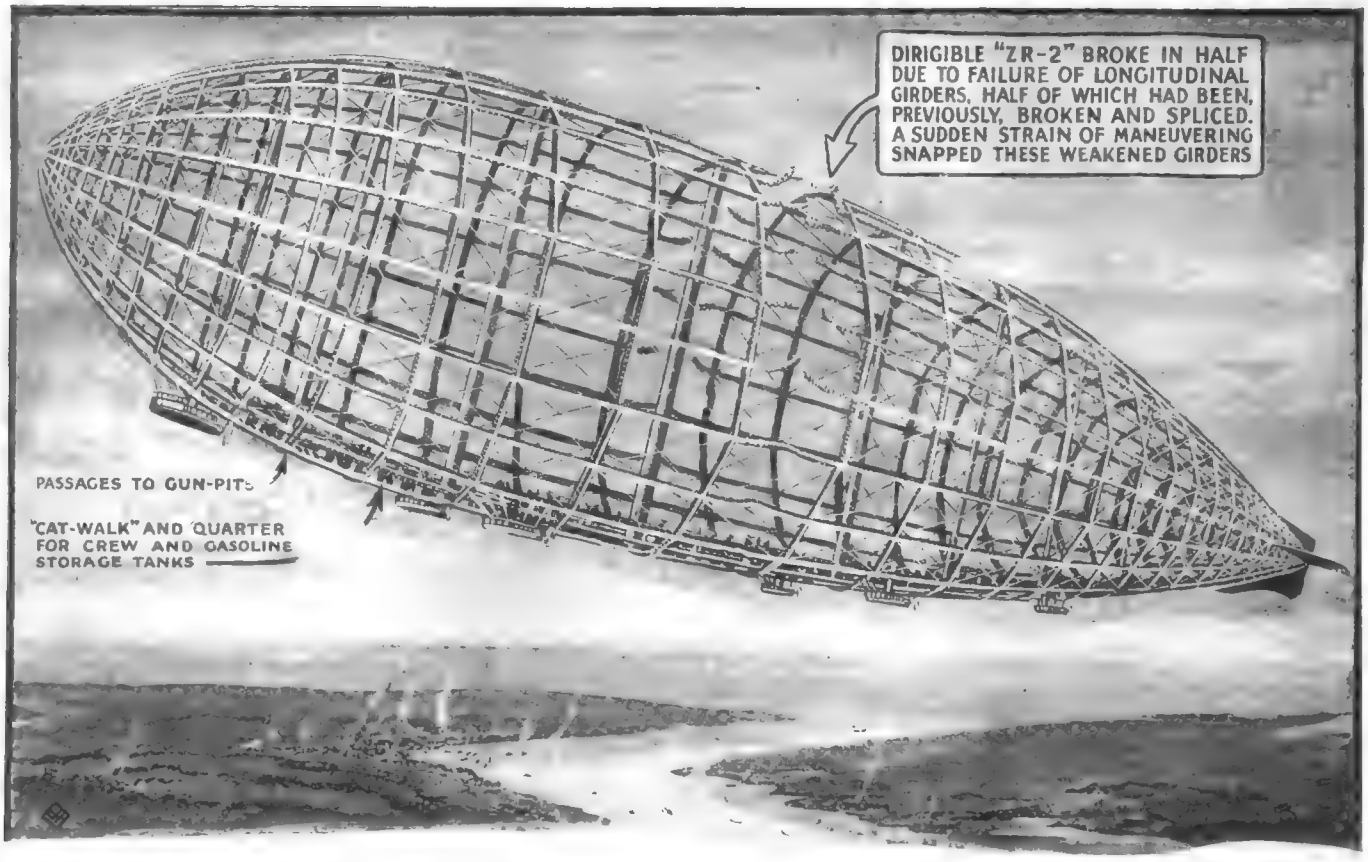
DIRIGIBLE "ZR-2" BROKE IN HALF DUE TO FAILURE OF LONGITUDINAL GIRDERS, HALF OF WHICH HAD BEEN, PREVIOUSLY, BROKEN AND SPLICED. A SUDDEN STRAIN OF MANEUVERING SNAPPED THESE WEAKENED GIRDERS
PASSAGES TO GUN-PITS
"CAT-WALK" AND QUARTER FOR CREW AND GASOLINE STORAGE TANKS

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This Skeletonized View of the Giant Dirigible R-38, Better Known by Its American Designation, ZR-2, Gives a Clear Idea as to the Position and Important Location of the Longitudinal Duralumin Girders, Which Are Thought to Have Broken Under the Severe Strain of Causing the Airship to Turn at High Speed. The Accident Is Thought to Have Occurred Because These Girders Were Not Properly Replaced by New Ones of Sufficient Strength, After Quite a Number of Girders Had Failed in Previous Tests. It Is Maintained by Aeronautical Experts That If the Balloonets of the R-38 Had Been Filled with Helium Gas Instead of with Hydrogen, the Two Halves of the Airship When It Broke in Two, Could Have Sailed Down Slowly and the Lives of the Crew Would Have Been Saved. Helium Gas Is Non Inflammable.

The Ill-Fated Airship ZR-2

THE accompanying photographs show the world's greatest airship-hangar, erected at Lakehurst, N. J., at a cost of $3,000,000, as well as the appearance of the ill-fated dirigible ZR-2 herself, the largest lighter-than-air craft ever constructed. The ZR-2 met an untimely end and killed over 40 English and American naval airmen, when she crumpled up and burst into flames over Hull, England, on August 24th, near the completion of an approximately 30-hour trial trip. If the giant dirigible had had her various compartments filled with the new helium gas which is non-combustible, as pointed out by Henry Woodhouse, President of the *Aerial League of America*, this terrible tragedy of the air could hardly have happened; or if thru structural failure of the girders the two halves of the airship had parted company, each section would have landed undoubtedly in safety, so as not to have killed nearly all of the crew, as actually happened.

It is understood that a sister craft to the ZR-2, which the British have also been building, may be substituted for the ill-fated Leviathan of the air, to fill the American Navy's order. As America's contract for the English-built dirigible called for a thoro trial of her flying qualities before the American naval air crew were to take over the ship, preparatory to flying her across the Atlantic Ocean, it is considered that the brunt of the loss will be upon the English builders.

CAUSE OF THE ACCIDENT.

It is probable that the true cause of the accident may never be known, but if hydrogen gas had started to leak from one of the balloonets near the exhaust pipe from one of the six powerful gasoline engines, the escaping gas may have ignited, and caused a primary explosion, which split the hull in two halves. An exploding gasoline tank could also have caused this; or as later reports seem to indicate, the great ship of the air apparently broke or started to break in two, before the first explosion, and the firing of the gasoline or gas may have been a secondary effect, caused by the failure of the structural beams, buckling the airship with a consequent disarrangement of the machinery, pipes and wires, which would have accounted for the spark which started the fire and explosion.

It is understood from earlier American official dispatches that sufficient helium gas was to be sent to England to inflate the ZR-2 for her flight across the Atlantic. Every effort should be made from this time on to eliminate the filling of lighter-than-air flying machine envelopes with any such uncertain quantity as hydrogen gas. Hydrogen by itself is not explosive, but as soon as it mixes with sufficient air, the oxygen brought into union with it, makes it a very dangerous explosive of considerable power.

The photograph showing the mastodonic hangar erected at Lakehurst, N. J., gives some idea of the engineering skill and money expended in building this great structure. The building is 800 ft. in length, 264 ft. wide, and 200 ft. high. The Woolworth building could rest easily on its side within it.

IMMENSITY OF THE ZR-2.

The ZR-2 measured 695 ft. in length, diagram from the nose of the balloon to had a diameter of 85 ft. 4 inches, a gas capacity of 2,700,000 cu. ft., could lift 50 tons and could fly to an altitude of 25,000 ft. She was driven by six 350 horse power gasoline engines, each engine driving a huge propeller. Her fuel tanks could hold 10,400 gallons of gasoline, which could make possible a full-speed radius of 6,000 miles at 75 miles an hour, of 9,000 miles at her normal speed of 50 miles per hour. In other words, an airship proportioned as was the ZR-2, had facilities for crossing the Atlantic Ocean and returning without re-fueling.

Her normal crew was 50 men and it required from 300 to 500 men, dependent upon the weather, to land her and place her in her hangar. The ZR-2 was fitted with suitable piping running her entire length, so that she could take on fuel and gas supplies from pipes extending to the top of a steel tower 200 ft. in the air, while she was anchored to the top of such a tower with a rotary coupling, which permitted the airship to swing all around the tower, with changes of air currents, during her anchorage.

This giant dirigible was fitted with the very latest type of radio apparatus capable of a range of 1,500 miles and special provision had been made so that in case the airship should become marooned in mid-ocean, an extra long antenna wire could be elevated by means of a small balloon and the transmitting range increased to 2,500 miles. An antenna wire 250 to 300 ft. in length could be quickly elevated with a small balloon in this manner.

COMFORTS AND APPOINTMENTS.

As in the dirigible R-34, a narrow corri-

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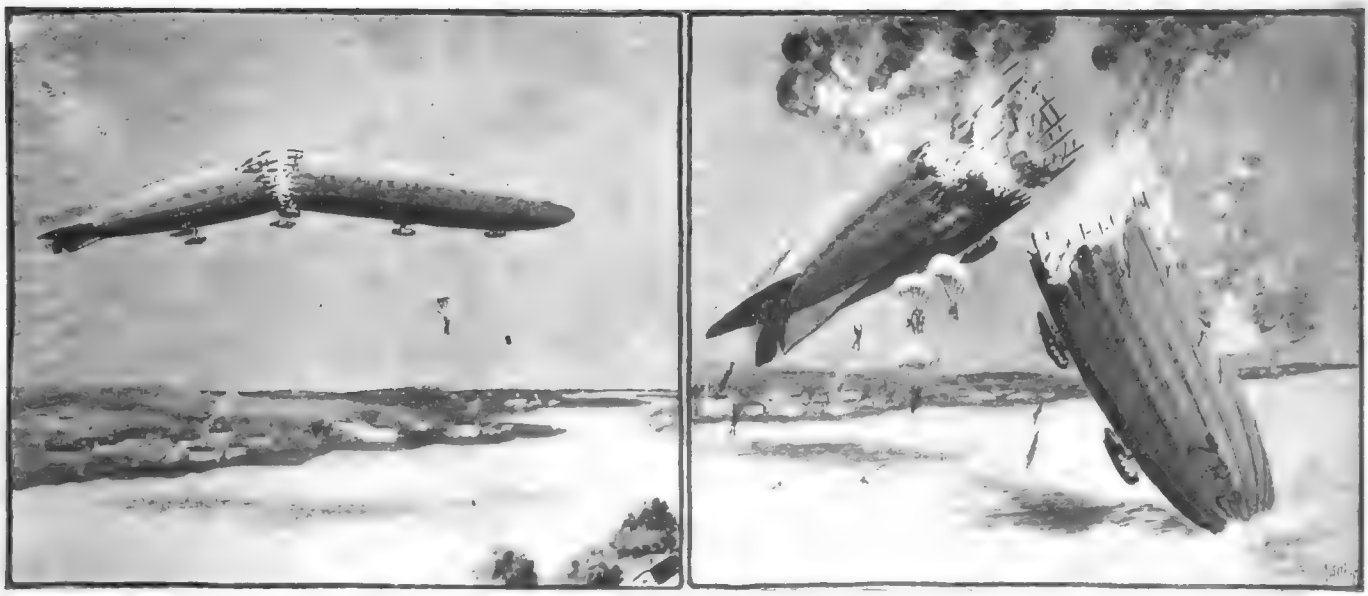

These Two Illustrations Show the First Stage, When the R-38 Broke in Two at an Elevation of About 1,000 ft., While the Second Illustration at the Right Shows How the Two Halves of the Giant Dirigible Burst into Flames as They Fell Rapidly. Some of the Best Aerial Experts in England and America Lost Their Lives in This, the Greatest Disaster in Aviation.

the tail, so that members of the crew could pass to and fro on their trips of inspection. In the R-34, the men had slept in suspended hammocks, in constant peril that a sway might hurl sleeper out and project him down thru the unprotected fabric of the balloon. In the ZR-2, bunks were constructed along this longitudinal runway, equipt with heavy covers and furs for cold weather.

In the R-34 the crew ate cold food on most of their voyage across the Atlantic because it was impossible to use any sort of cooking apparatus so close to the inflammable hydrogen. The men on the R-34 did, however, get a sip or two of hot tea daily when some member of the crew took time to heat a kettle of water over the exhaust pipes of the motors.

Contrivances to permit the use of this heat from the motors were built into the ZR-2, and the members of the new ship's crew were to have had hot roast beef, bacon and eggs, soup, tea, coffee and other hot dishes.

NEW NAVIGATION APPARATUS

New contrivances for the navigation of the balloon also had been invented since the R-34 was built. One of these new instruments, a radio compass, was described by Lieut. Commander Robert Evelyn Byrd, U. S. N., who was to navigate the dirigible to this country. We quote from the *New York Times*:

> *It will take a long time for Americans to forget the terrible tragedy of the air which occurred only a few weeks ago when the R-38, better known to Americans as the ZR-2, broke in two at an altitude of approximately 1,000 ft. and burst into flames, while falling to earth, over Hull, England. It is hard to tell now, until full inquiry has been made by the English Board of Experts, who are to meet shortly, just what happened when the world's greatest dirigible snuffed out the lives of nearly all of her crew.*
>
> *It would seem to us, however, as pointed out by several of the leading American aeronautical experts, that had the balloonets been filled with the new non-inflammable balloon gas, helium, the two halves of the great gas bag when she broke in two, could have reached earth safely.*

"We will use this new radio compass, as well as the aircraft sextant, which has an artificial horizon and does not require sighting the sun from the sea's surface."

An electric dynamo attached to one of the main motors furnished electricity for lighting all the rooms and cabins of the airship and for an immense electric searchlight that would enable the airship at night to pick out her mooring mast or to sight or signal to the earth.

Unlike the R-34, which had sand ballast, the ZR-2 had water ballast distributed in tanks along her keel, and by touching buttons on the "bridge," the captain of the ship could release ballast, or by touching other buttons deflate hydrogen gas. The gasoline supply, also in tanks along the keel, could be regulated and controlled from this bridge, which was attached to the framework of the balloon between the two forward cars. The steering and altitude apparatus also were controlled from this bridge.

The R-34 had to be hauled to the ground when she needed more fuel, and lines of hose were strung into her structure, but the ZR-2 was a step forward in airship construction in this way. Thru special piping in her bows and other apparatus in the interior, the big ship could suck up oil, gasoline and water ballast while floating at the top of her mooring mast, 200 feet in the air.

Photo at Left Shows the Gigantic Hangar Erected at Lakehurst, N. J., Which Was to House the R-38. This Immense Building Measures 800 ft. Long by 264 ft. Wide, and Is 200 ft. High. It would House the Woolworth Building on Its Side Easily. Photo Above Shows the R-38 Leaving Her English Hangar for a Trial Spin Thru the Air.

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Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

NO. 3—THE SECRET OF SUSPENDED ANIMATION

[Author's Note:—It is beyond question that in the course of a very few years we shall find means of putting a man to sleep for a period of one or more years, and of awakening him again whenever we wish to do so. Without putting any credence in the tales of suspended animation told of the Hindu fakirs, we have but to consider the well authenticated cases of hibernation familiar to all of us. When we see that a warm-blooded animal like a bear can sleep thru the winter months, living on its own fat, there is no reason why a man, under proper conditions, could not accomplish the same feat. And if the conditions in which he were placed were such as to reduce his expenditure of energy to a minimum, there is no reason why this sleep of hibernation could not be considerably prolonged. I have endeavored to show in this story what practical advantages this suspended animation might possess.]

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". . . The Uncouth Antediluvian Creature, with a Loud Snort, Stretched Out Its Bony Wings and Soared Away Over the Tops of the Houses. . ."

"NO, Mr. Rockett," said Doctor Hackensaw, shaking his head, "No, I do not place the slightest faith in these tales of *suspended animation* that are related of the Hindu fakirs."

"But, doctor, there are a number of such cases on record, and some of them seem pretty well authenticated," remarked Silas Rockett, who, in his quality of reporter for the New York Daily Growl, had called to have another interview with the worthy doctor.

"I remember one case in particular," continued Silas, "where the experiment was conducted in the presence of a French army officer and his men. They saw a Hindu native put into a trance, his nose, mouth and ears plugged with wax. He was kept in this state for six months or a year and then restored to life again, none the worse for his long sleep. What have you to say to that?"

"Nothing, except that I don't believe it," returned the doctor. "I have had people tell me they saw a conjurer take a man's watch, crush it to pieces under his foot, cram the fragments into a pistol and shoot them at a target, where the pieces reunited to form the original watch again, and hung suspended from the centre of a target."

"Yes, but that was avowedly a trick."

"True; and it depends upon substituting a duplicate watch for the original one. So, I believe, from the accounts I have read, the Hindu fakir substitutes a dummy for the man put into the trance."

"Then you do not believe in suspended animation?"

"On the contrary, I am a firm believer in it. There are too many really authenticated cases of suspended animation in nature, for a scientist to doubt the facts for an instant. Among the lower invertebrates, including the microbes, there are many well known cases of individuals remaining in a state of total inactivity for months and even for years, yet coming to life again when external conditions are favorable. Among higher animals, hibernation is also frequent, and even a warm-blooded animal, such as the bear, sleeps thru the winter months, and comes forth hungry from his den in the spring."

"Then why is it impossible that a man should do the same thing?"

"It is so far from being impossible, that I have accomplisht the result myself. But I claim to be the first man who ever succeeded—I do not believe the Hindus ever did anything of the kind."

"You mean to say, doctor . . . ?"

"I mean to say, Mr. Rockett, that I have not only succeeded in putting animals, like the cat, dog, horse and cow, to sleep for several months at a time, but I have also done the same thing with human beings. In fact, if you will step across the way with me, you can see some of the subjects for yourself."

So saying, Doctor Hackensaw led the way into a long, low building, around whose sides were ranged tier upon tier of glass coffins, some empty, but most of them containing either one or more animals, or a human being in a state of complete coma.

Silas Rockett gazed about him in amazement, scarcely believing his eyes. But Doctor Hackensaw continued as calmly as if he were delivering a lecture in his clinic:

"It has always been a matter of surprise to me," said he, "that our scientists have not long ago solved this problem of

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A Record-less Phonograph

By W. F. COWGILL

IT was during the spring of '17 when phonograph factories sprang up like mushrooms over the land, that I drifted into the experimental room at Wassenbach's. We had gone to school together, Wassenbach and I, and he had sort of taken to things mechanical and electrical, so I was not surprised to find him with a small well-equipt phonograph factory and a few workmen who were making some really good instruments.

It wasn't a big beginning, but Wassenbach was in it, heart and soul.

"There's lots of room for improvement, Carson," he said, "in the construction of a phonograph. Just keep your eyes open and some of these days I'll show you what I mean."

About this time war clouds began to hover low and menacing, and Wassenbach, being of German descent, disappeared.

I found him the other day in a Western city. He dragged me out to his home and into his study.

"Got something new to show you, Carson," he said, indicating with a gesture an instrument much like the ordinary phonograph in design and finish. He motioned me to a seat and handed me a catalog of one of the most prominent record manufacturers.

"Make a few selections, Carson," he said, "and while listening to the reproduction of some of your favorites, you may watch the action of my newest invention."

I was puzzled by Wassenbach's words. "You don't mean to say," I began, "that I can make a number of selections from this large catalog and that your collection of records is so complete as to embrace all that I choose?"

"That's it exactly," said Wassenbach, "but it doesn't just happen so. You will notice that each record catalogued is numbered in the usual way." He stept to the instrument and opening a little slide, called my attention to a neat row of buttons, numbered from one to ten.

"Make any selection you like from the catalog," he said, "then we simply indicate the numbers one at a time on the buttons, release the lever and enjoy the music or whatever it may be. We could well adopt the slogan 'You press the button, we do the rest.'"

I turned to the popular records where I found "Kahala March." I called off the number to Wassenbach. He clicked them off on the buttons, and immediately the sweet low strains of my favorite Hawaiian selection filled the room with melody. But my thoughts were upon the wonderful mechanism that made this possible.

"You are not telling me that you can play any selection listed in the catalog!"

"Exactly." Wassenbach noticed my evident curiosity to see the mechanism by which so many records were handled, and opening a door on the side of the instrument, he smiled at my surprise, for the only thing to be seen was a sort of diafram and a couple of wires running from this thru the back of the cabinet.

Then it dawned upon me that the music was not really made in the instrument but was coming from some other source.

"How is this, Wassenbach," I said, "Where are all of those thousands of records located and ——" A half dozen questions half-formed themselves on my tongue as I tried to imagine the complicated mechanism by which such a result was made possible. It was a wild flight of the imagination. "I suppose," I said, "that you have hundreds of disc records running on one central axis with a tone-arm, a diafram and needle for each. Then when the proper electrical connection is made, the proper tone-arm and needle drops on the desired record and the music begins. Am I right?"

"You are partly right, Carson," he said, "and very much wrong. First you should know that the complicated mechanism which makes it possible for any family receiving the service to have any selection that is listed in the catalog, is nothing more or less than the old Automatic Telephone System put to a different use. When the company announced its intention of disposing of the service in favor of the Weston company, I bought the equipment. I secured a surprisingly large number of subscribers, put cabinets in place of the

(*Continued on page* 542)

Today Most People Who Own a Phonograph Have to Wind Up the Spring Motor Each Time a Record Is Played, and Not Only This, but There Are the Records to Handle with the Consequent Frequent Breakage, etc. With the Record-less Phonograph Here Shown, One Will Have but to Press a Series of Buttons Numbered from 1 to 10 When Any One of Several Thousand Selections Will Be Instantly Rendered Thru Their Talking Machine. All of the Master Records Are Placed in a Central Exchange and When the Buttons Are Prest in the Proper Sequence on Your Parlor Phonograph, Automatic Switches Are Actuated at the Exchange to Connect the Desired Record and Reproducer to Your Circuit. The Poulsen Telegraphone Principle Is Employed Giving an Absolutely Perfect and Scratchless Reproduction.

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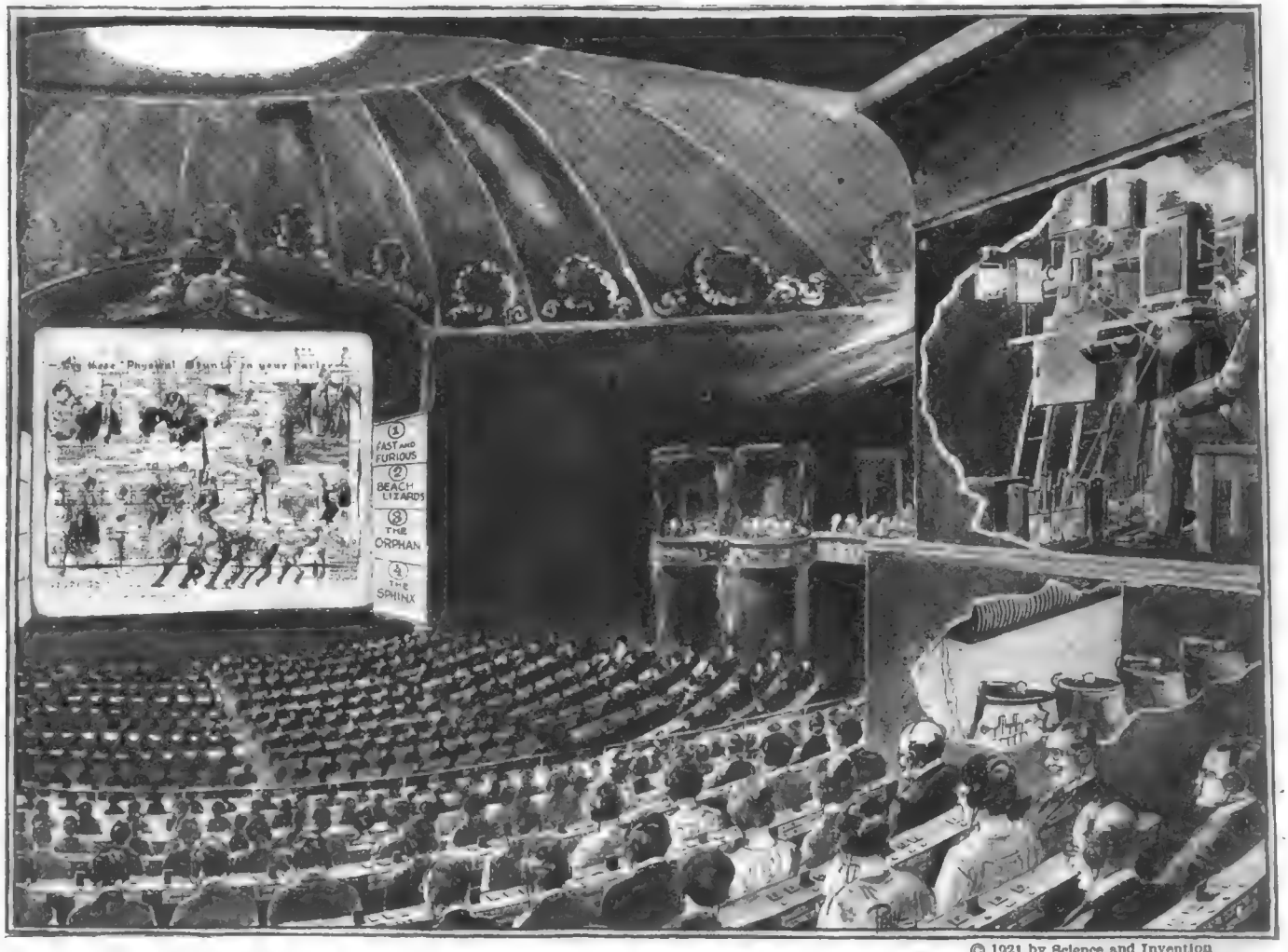
A Scientist's Dream of Future Movies

TODAY when you purchase a ticket to see a motion picture show, you can only see one film thrown on the screen at any one time. But tomorrow, says the scientist, things will be changed. You will not be limited to one film, but can see any one, of a dozen or more, all for the price of one admission, at any time, and all from the same seat; comedy, drama, science,

This wonder movie theatre is a large spacious hall fitted with arm chairs, and as we enter it, we see all about us people in different moods—some gay and others not so gay. Each one has fastened over their head an ordinary pair of telephone receivers, and each one is viewing a picture with different colored eye-glasses. Some are laughing, some have tears coming from beneath their glasses, and still

program we see that a play featuring Madame Petrova will be Number 4 on the list, and perhaps the spectator will be provided with a combination of glasses more bluish in color. Others again will like a submarine feature, and will see "Wet Gold" under Number 10, the Williamson production. Therefore, should we be inclined to see that exhibition we put on the specified lenses and adjust the ear-



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The Motion Picture Play of To-morrow as Forecast by One American Scientist, will Undoubtedly be Considerably Different from the "Movie" Show We Know To-day. He Suggests That We Will Have Several Different Photo-plays, Comedy, Drama, etc., Flashed on the Screen in Different Colors Simultaneously. To View Any Individual Photoplay, We Will Move a Switch on the Back of the Chair Ahead of Us, Which Will Release the Proper Colored Glasses to View a Comedy, Flashed in Red Let Us Say; and at the Same Time the Proper Synchronized Phonograph Music Will Be Supplied to the Head Telephone Receiver Which Each Patron Wears. If We Don't Like the Comedy, We Can Select a Drama or Travelog and Observe Them Thru Another Pair of Properly Colored Glasses—With Music to Suit.

travelogs—all will be at your instant command. On the back of the seat in front of you there will be a clever selective device, which will release the proper colored glasses to view the particular movie you want to see, and simultaneously switch into circuit the proper music for the telephone receiver you snap over your ear. Several motion picture projectors flash their views on the screen simultaneously, each one in a different color. To each projector is connected—synchronously—a phonograph fitted with the appropriate music. Audion amplifiers intensify the music sufficiently to supply hundreds of chair phones. The colored glasses act as filters. To see comedy, for example, you use yellow filter glasses, which permit only this color to be seen. Red glasses show us a melodramatic film, if that is the color used to portray it, and so on down the list.

others are in an intense mood of excitement. We take our place in any empty seat which we can find in this packed house, and look up towards the screen. On either side we see the names of the features upon an electrically illuminated sign and immediately under these names, the actors playing the leading roles. Should we feel in a mood for comedy, we push the slide on the back of the seat in front to a point marked "Number 3," for instance. An automatic catch now releases a pair of special colored glasses from this compartment. We adjust these glasses and also a pair of telephone receivers provided on each chair, and we are able to see for instance, a Charlie Chaplin comedy and hear music appropriate to the same. Our companion may not be interested in the Chaplin comedy, and may like something more serious. So elsewhere on the

phones which are, of course, automatically connected to the circuit carrying the proper music for the play.

The busy man or woman who can devote but a short time to entertainment, can learn and see more in one evening in this manner, than we would ever dream of today. If thru the red glasses he beholds a dramatic picture, which does not please him, he could immediately shift to a scientific feature or to a howling comedy. Everyone will be happy because they have at once their choice of several different classes of entertainment, and for the movie fiend, who delights in watching a picture show for four or five hours, he or she could sit there and view everything on the program.

Of course it will be quite a problem to select glasses which will operate properly.

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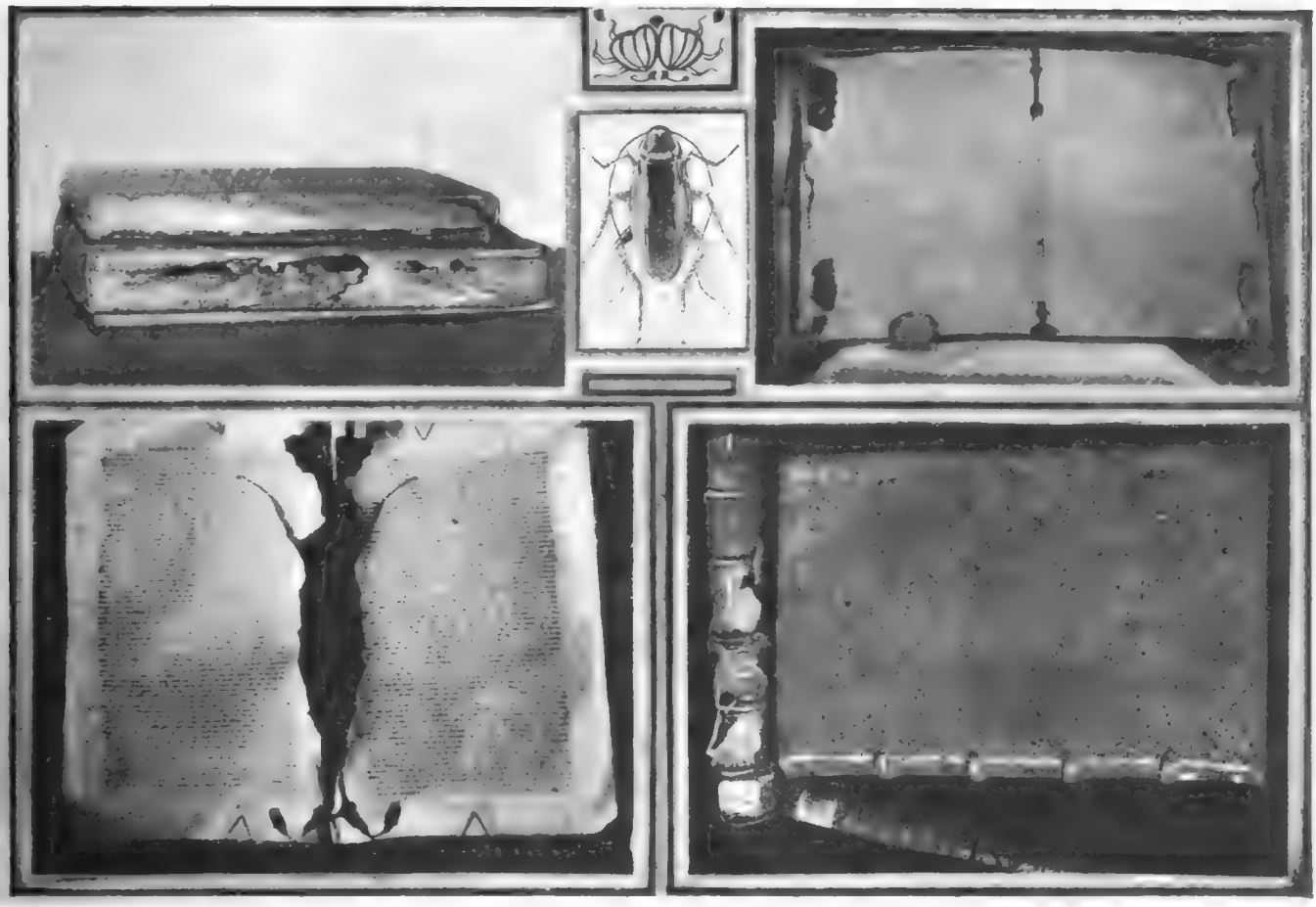
Bookworms

By WILLIAM R. REINICH



Our Illustrations Show Various Examples of the Work of the Many Kinds of Insects, to Whom the Popular Name of Book-Worm Is Affixed. Sometimes All the Organic Matter Is Devoured, Leaving Nothing but the Clay Filling of the Paper. North and South America and the Sandwich Islands Contribute Examples.

IN the earliest writings that we have knowledge of we find mention of the ravages of the bookworm. Evenus, who lived about 450 B. C. is the earliest author known to write of its ravages. Horace, Ovid, Pliny, Martial and Lucian also do not overlook him.

In 1665, Hork in his "Micographia" gave the first illustration of a bookworm, which is that of a silver-fish, and which today is known to do considerable damage to coated papers and photographs.

Austin quotes the following from the writings of Christian Mentzel, the German naturalist and philogist, who lived in the seventeenth century. "When one reads that he heard the book-worm crow like a cock," and said, 'I knew not whether some local fowl was clamoring or whether there was but a beating in my ears.' one cannot help wondering if there was not something defective in his ear drums; but further on he says, 'I perceived on the paper whereon I was writing, a little insect that ceased not to crow like a chanticleer, until taking a magnifying glass I assiduously observed him.' From this one concludes that if the fault was not with his hearing, by which some well-known sounds made by book insects seemed to him like the crowing of a cock, an altogether different cock from the kind we know must have lived in his day."

As years past, the constant destruction of books by insects was noticed, especially when some rare or unique copy of those priceless gems of early bookmaking, the incunabula, was destroyed or ruined beyond redemption, and scientific societies offered prizes for remedies to prevent this loss. Even as early as 1774, the Royal Society at Göttingen offered a prize, and in 1903 the International Library Congress at its meeting in Paris, also offered prizes for remedies. Some of the governments of the world have also given considerable attention, not only to find a preventive to protect the paper from the insects, but also the cloth and leather bindings, which are subject as well to the attacks of insects.

No locality seems to be safe from their depredations, except, perhaps the Arctic regions. Dry, moist, hot, and cool regions each contain insects which require these conditions for their existence, and consequently there is no protection for the books. I have examined books attacked by insects from almost every part of the globe, and from many states of the United States.

It is very curious to see the various ways in which books are damaged or destroyed. In some instances one will find only one or two little borings, running through them; again, you will find hundreds and even thousands of tunnels. Or, a little tunnel will start and lead into a cavity the size of a pea or a large walnut, and from this excavation, other channels will start, ending perhaps in other chambers. A number of pages may be so badly eaten, as to give the pages, when held up to the light, the appearance of a piece of rare old lace. Again, books may be literally cut into strips, or even flakes, reminding one, when the book is taken off the shelf, of a miniature snow-storm. In one instance two volumes, whose paper had contained quite a quantity of clay as a filler, had been transformed by the white ants, the insects which had attacked them, into two lumps of earth. No paper seems to be exempt, each kind, rag, wood, etc., seems to be attractive to the particular group of insects, which destroyed the substance in its natural form.

Bindings, both leather and cloth, have special attractions for insects, who do not seem to care for the paper, and even the dyes used in coloring the cloths or tanning the leather appear to act as an appetizer in some instances.

As to what insect can be given the name of the bookworm, it is difficult to answer. The little brown beetle, called *Sitrodespa Panicea,* is generally called the bookworm, but there are over a hundred other species, some of which do many times the amount of damage done by this species.

As destroyers of paper, the white ants, would receive the honor, not only in the quantity but also in the rapidity with which they accomplish their work, and as they do not come to the surface, only making a small hole to gain access, which one would scarcely notice, their ravages pass unnoticed until the book has been destroyed.

There are quite a number of species of beetles, which do considerable damage, especially to paper containing wood-pulp. The paper containing a large percentage of rags are generally attacked by some species of moths.

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Revealing Your True Vocation

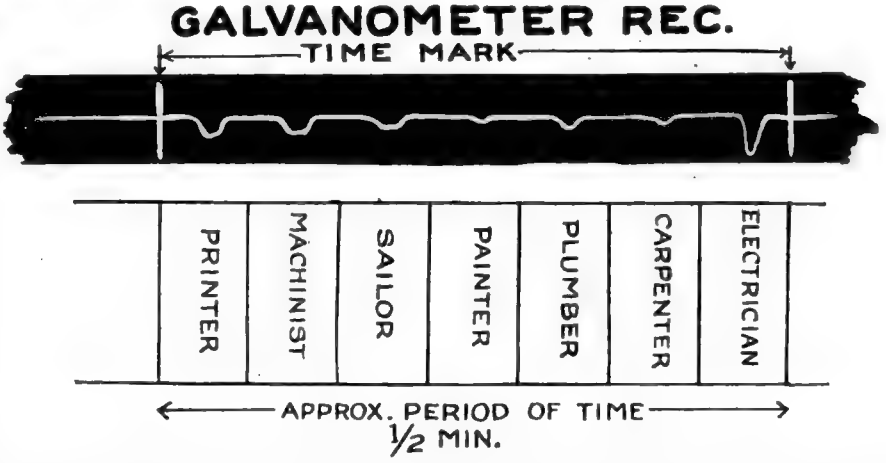
By Dr. M. P. VON DAVID, M.D.

INDIVIDUALS of man are as distinct in habits and appearance as any other form of animal. Sadly, however, by reason of easy and voluminous communication with fellow men, the individual is often led, coerced, or wheedled into some particular vocation for which he is entirely unadapted. We find artists selling life insurance, philosophers digging ditches, and plumbers practising medicine. The idea of all mankind being free and equal is utopian, illogical, and absurd. I could never believe that even at birth, all mentalities of even normal babes, were equal. Brothers, or sisters, born of the same parents, raised in the same environment, and given equal opportunities, are diametrically opposed in tastes, habits, and character; this is a fact of common experience. To a brilliant mind which is capable of original thought, orthodoxy is galling; to a less precocious nature, original and radical deviations from "The Law" are gaffles in its conscience.

The most practical and valuable aid that can be given to this struggling race is *not* a rabid doctrine that treats the race as it should be in a utopian dream, but a method of determining the individual capability and inclinations of men *as they are*, and then directing them into that vocation which will use these natural capabilities to best advantage. If your son is well adapted for a teamster, do not try to make a futurist artist of him. This may sound overdrawn, but such incongruities are a daily experience with most of us.

Teachers and parents often ruin a child's natural career by choosing a vocation for him for which he is totally unsuited. A child's brain is a very sensitive organ. The "Nervous Renaissance" which transpires at or near the age of 14, heightens this sensitiveness. Mutual confidence is all important at this time, between child and parent; and an offending word or act from an older person may easily warp the child's budding philosophy of life. If you would keep the child's implicit confidence, do not expect him to be 30 when he is only 14; nor do not treat him as tho he were 9. Strive to treat him as a child of his own age. Exaggerating his mental age discourages him; underrating it, disgusts him; either will bend his confidence away from you. This principle may be well applied to persons far beyond 14 years of age.

Dr. Augustus Waller, Director of the Physiological Laboratory University of London, Is Carrying Out Experiments with an Instrument, Which Records Human Emotions. Attaching a Hand of a Patient to a Galvanometer, He Shows how His (the Patient's) Emotions Were Recorded by Means of a Spot-Light on a Screen. The Wiring Was so Arranged that Any Emotive Impulse from the Brain Down the Motor Nerves to the Hand, Deflected the Spot to the Right. Picture Shows Dr. Augustus Waller Standing Behind the Table.



The Section of Galvanometer Tape Shown Below Illustrates Just How You Will be Chosen for Your Vocation and Career When We Have Adopted the Electrical Method of Analyzing Your Brain Impulses. The Front Cover Illustration Shows How the Names of the Different Trades are Flashed One after Another Before the Subject; the Maximum Galvanometer Deflection, When Matched Against a Chart Containing the Trade Names, Indicates Which Trade the Subject Is Best Fitted for. In This Case It Is "Electrician."

THOUGHT AS RADIANT ENERGY

The conception of thought as radiant energy is not new. It has been suggested by philosophers and physicists for ages. The ancient terminology may differ slightly from the modern term, "radiant energy," but the idea of thought being of the same general nature as heat, and light, is old. There is no absolute direct evidence of this identity of thought and radiant energy, but there are a number of indirect indications of such a relation. Telepathy may be considered a very strong point in favor of this idea. There are scoffers of course, who deny even the existence of such a thing. I do not presume to convince these doubters; that can be better left to those who have little to do, and who expect to live longer than I. My personal experiences in America, Europe, and in India, leave no doubt of the slightest nature, in my mind, of the reality of telepathic communication.

Another and more indirect evidence of our concept of thought is the "n-ray" which was discovered by Professor Blondlot of the University of Nancy. He found evidence of a new form of light (radiant energy), which seemed to have its source in muscles under tension. Sufficient work has not been done to fully understand the nature of these rays. But the fact that muscles in tension radiate a form of energy, brings us closer to the idea of thought being in the same class of phenomena.

The discovery of radioactivity in the latter part of the 19th century, opened new vistas of ultra-physical research, which have hardly been outlined by the surveyor's chart. Among the few elementary things we have gleaned from the research work done so far, there is one outstanding fact, which verifies the alchemist's dream. Radioactive substances are continually changing in chemical and physical properties. They are transmuting from element to element, each element being individual unto itself. It emits its own ray or combination of rays; it has its own atomic weight, specific gravity, and all other physical properties assigned to elements. From Uranium, the parent element of the radium series, there is a steady decomposition, from element to element.

It is a matter of experience that in concentrated thought, energy is expended. Perspiration may be induced by concentration, and without the slightest physical effort. The source of the energy inducing such perspiration, must be decomposition—decomposition of the Niscel bodies employed during the process.

(Continued on page 554)

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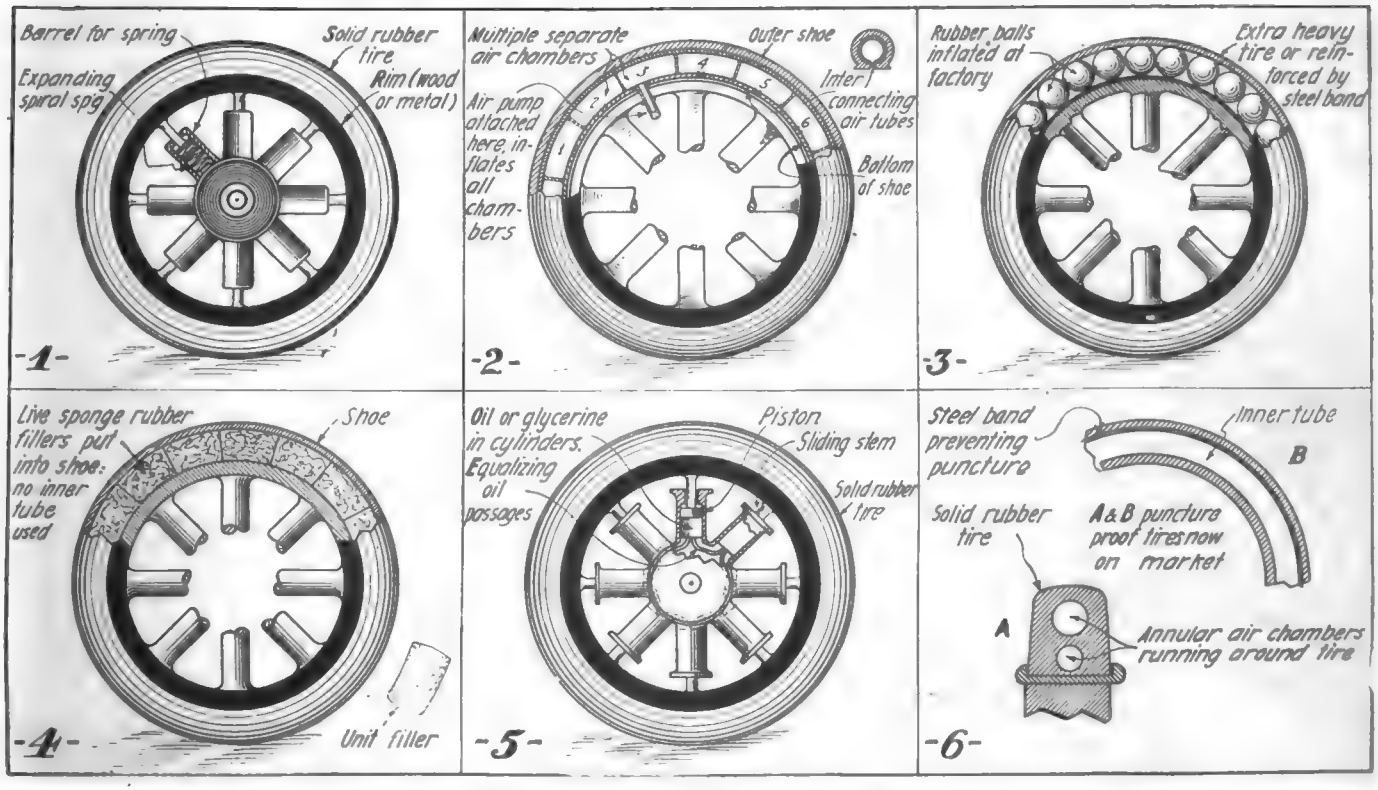
Pneumatic Tire Substitutes



Thousands of Dollars Await the Inventor or Inventors, for There Is Plenty of Room for More than One Design, Who Will Perfect a Satisfactory Substitute for the Present Day Pneumatic Tire Used by Thousands of Automobilists the World Over. Several Novel Ideas are Shown in the Accompanying Illustration Which May Serve as an Incentive to Inventors in Finally Perfecting a Satisfactory Tire, Which Will be Practically Puncture-Proof and if Possible be Non-Pneumatic; and That Is Sufficiently Resilient Without the Use of Comprest Air.

NOW that automobiles have become such a commonplace affair in our daily lives, one being owned by every tenth family in the United States, the subject of tires is of ever-growing importance. Who likes blow-outs? The answer is—Nobody. Not only is this so because we have to get out, and soil our Sunday clothes perhaps, on a muddy road to patch up a punctured inner tube and replace a shoe; but there is a very distinct danger for those who drive at speeds of 35 to 40 miles per hour or more, for a blow-out may cause the machine to swerve from the road and go over an embankment, or else throw the machine on its side, or upside down, which cases the writer has seen exemplified in two fatal accidents near his home this summer.

In the accompanying illustration several new ideas in automobile tires are presented. Fig. 1 shows a new spring wheel which a Jersey City, N. J., inventor is developing for commercial use. This wheel uses a solid rubber tire and the proper amount of resiliency is obtained by the powerful springs placed in the interior of the spokes. Each spoke is a compound affair comprising a stem secured to the rim, and as this spoke comes to its lowest position, the spring is partially comprest by the load. This form of wheel gives promise of developing into something worth while it would seem.

Another suggestion which is illustrated for the design of a more reliable automobile tire is one having multiple air chambers, shown in Fig. 2. The successive air chambers are connected with a common air pipe, as shown, so that when the pump is connected to the single air valve, all of the chambers will be inflated simultaneously and equally. Each short inner tube member, 1, 2, 3, 4, etc., are fitted with an automatic check valve, so that in the event that one of the chambers is punctured, it will not allow the air to escape thru the puncture from all the other chambers. Substantial rubber walls are molded inside the tire to separate the air balloonets. This is the same principle as that followed in building the modern dirigible airship.

Why not employ a tire filled with inflated rubber balls, as shown in Fig. 3. This idea was suggested by Mr. H. Gernsback. Of course, with this design of tire the outer wall of the casing should be made extra thick and heavy with possibly a steel band or other semi-rigid member molded or wrapt in with the rubber and cord, in building up the tire, so that there will not be a tendency in passing over small stones, et cetera, to push the tread inward between the rubber balls. Mr. Gernsback's idea is to have these rubber balls inflated at the factory where they are made.

In case one of the balls should be punctured, then with this scheme the air from the other balls could not leak back and out thru the punctured unit. For trucks, Mr. Gernsback suggests that a steel or other band be made to encompass the ring of balls and allow only a small part of their surfaces to project thru holes in the band.

An idea which was put on the market with some success a year or two ago, is that illustrated at Fig. 4, where live sponge-rubber fillers are fitted into the shoe, without using any inner tube at all. The round sponge-rubber sections measured several inches in length and could easily be forced into the shoe; the latter was then placed on the wheel rim. Whether this arrangement would provide the desired degree of resiliency, as compared to a pneumatic tire, is the problem. At any rate it was a mighty good start in the right direction, and eliminated the tube full of air always liable to blow out or leak, which we are now using on our cars.

Another one of Mr. Gernsback's ideas for a substitute to take the place of the pneumatic tire with its inflated tube, is shown at Fig. 5. Here he has proposed to have the spokes made in the form of small pump cylinders and to have these filled with oil or glycerine. All of the cylinders are connected together by small openings or channels so that the oil or other liquid can pass out of one cylinder and into the other at all times, and thus compensate for the load on any one or group of cylinders.

Speaking of puncture-proof tires commercially available at the present time, let us glance at Cut. 6. At Cut. A we have with us a solid rubber tire which has been devised with two annular channels or air chambers running completely around thru the rubber, thus providing a fair degree of resiliency. At. Fig. 6-B, a sectional view is shown of one of the few puncture-proof tires now on the market. This tire is not any more expensive than any good cord tire, but is built extra heavy, and is provided with a steel band in the center underneath the rubber constituting the tread, so that nails or any other similar objects cannot pierce thru to the inner tube. Another attempt in this direction, which has been commercially exploited, is a shoe built up with a heavy leather tread, this tread being finished off with a jacket of heavy steel rivets. As the leather is much tougher and stronger than rubber, it is evident that such a shoe could be driven over almost any kind of nails, glass, etc., without suffering a puncture. This was the form of tire used on the army automobiles in the war zone, the makers have stated.

Sometime ago one of the large American rubber companies started to advertise in

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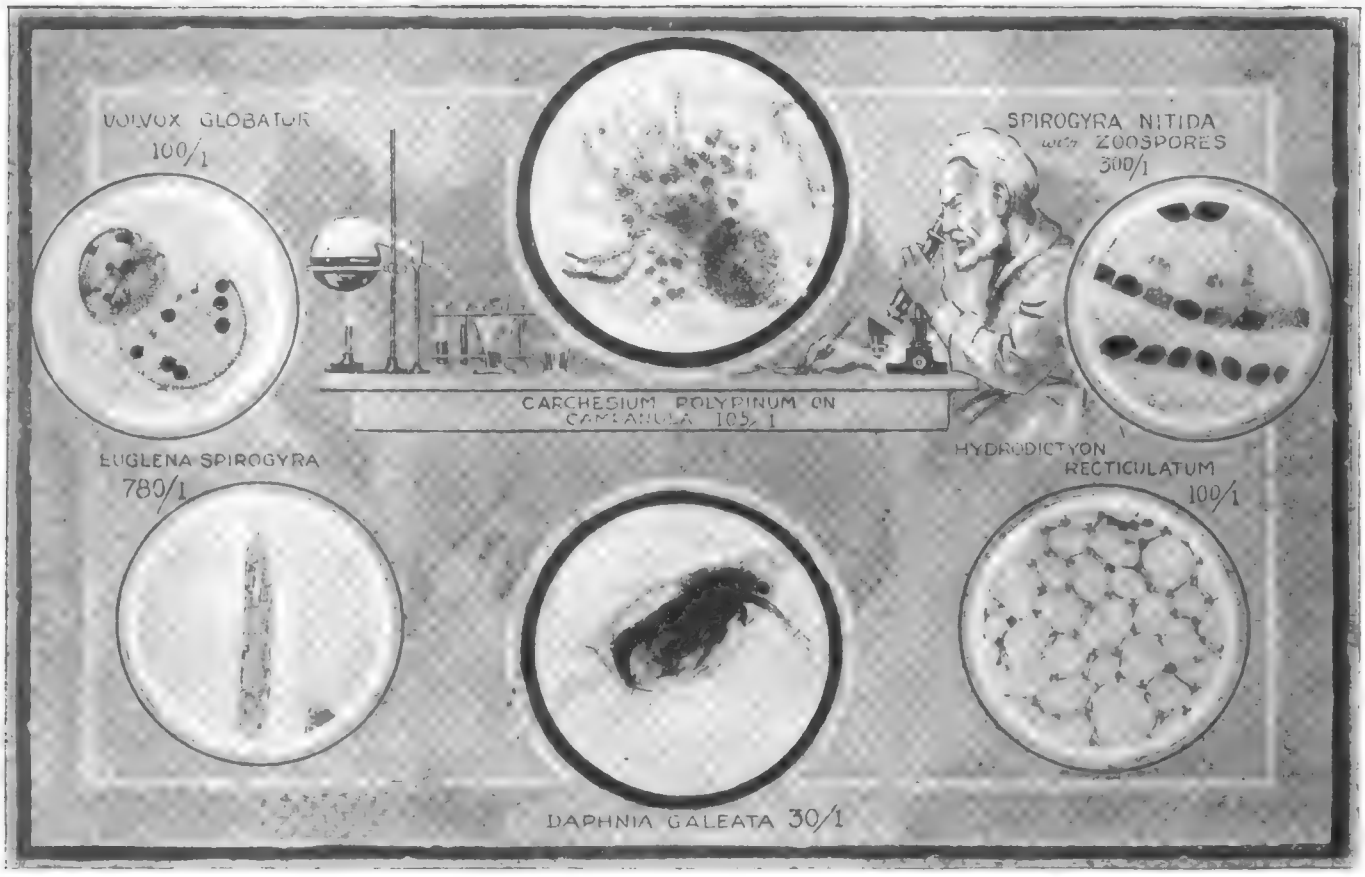
Just a Drop of Water

By Dr. ERNEST BADE

WHO would suspect that some of the most beautiful animate objects were hidden within a drop of water? An example of life, whose organization is so low, that both the botanist and the zoologist claim them for their own, altho neither is absolutely certain whether the specimen before them is plant or animal. Every pond, puddle, and pool shelters these curious organizations, and an especially rich harvest may be gathered from all those woodland lakes which are far from the haunts of man. Here the water-lily covers the entire surface of the water comes to life so that each puddle is microcosmic in character. Rain water, after it has stood in the puddle for some time, becomes cloudy, and this cloudiness, which is due to a process of decomposition, becomes more intense from day to day. As the first bacteria disappear and decay, others make their appearance. The newer and more recent varieties, which take the place of the older, assimilate the carbon dioxid. All these bacteria are tiny, one or more celled plants. When under the microscope, a drop of water shows us these little plants in lively commotion, as life pulsates thru their tiny forms. any manner with an expression of will power.

The beautiful Desmidiaceae have no silicious cell membrane. These algae are the inhabitants of only the clearest of waters, even a slight polution causes their death. Higher representatives of the algae family are the green algae. The best known forms of these plants develop fine green threads, others branch out profusely, either clinging to some foreign substance or floating about in the water where they develop into dense, thick masses, interweaving themselves not unlike felt, while still others resemble dainty networks of gauze.



The Micro-Photographs Reproduced Above Were Taken by Dr. Bade in His Laboratory and Illustrate Some of the Remarkable Organisms Which Fight for Life in a Little Drop of Water. We Are Sure That the Accompanying and Popularly Written Article by Dr. Bade on the Wonders of Animal and Plant Life Existing in Water; This Description of These Creatures, So Tiny That They Can Be Seen Only Under a Powerful Microscope, Will Prove of Valuable Interest to Everyone. The Magnification in Diameters Is Given for Each of the Specimens Illustrated in the Group

as if it would protect the tiny microscopic life beneath their leaves from profane touches.

These diminutive objects are surprisingly far-reaching and divergent in their range, and this sea of the smallest becomes deeper and deeper as we penetrate into the mystic depths, for newer, still smaller worlds border upon those just conquered.

If, after a heavy thunder shower, the depressions of the ground have become filled with water, and if the sun has played upon the water, many and various forms have sprung to life under its influence. Such a shower gives life to thousands of organisms which, before the rain, have slept the sleep of the dead. Sparks and signs of life are found every where, but the necessary conditions of life are not favorable in every place. The rain water gives life to all those things which have been lying dormant during the dry seasons of the year. In these pools everything Some tremble upon one and the same spot, while others rush and chase about in the wanton joy of a happy life, for bacteria possess whiplike threads which enable them to move rapidly thru the water.

As time goes on, the water again becomes clear, but before this is entirely accomplished, delicate green algae (plant structures) appear, covering the entire bottom, while wonderfully beautiful diatoms grow in the greatest profusion. Some of them have such fine and delicate shell markings that not even the most powerful microscope has, as yet, been able to show us with any degree of accuracy and fidelity their more than minute wonders. The silicious shell-like cell membrane of these algae are divided into two halves which fit snugly together, not at all unlike a box with its lid.

All diatoms living free in the water show a peculiar gliding motion when passing over other things. But this is purely mechanical and can not be connected in

The propagation of these algae is very interesting indeed, for many resemblances to the propagation of the lower animals may be noticed. One of the asexual methods of propagation is accomplished thru swarm spores possessing their own motion of locality. When one of these spores suddenly bursts, a protoplasmic green ball having a crown of long lashes, escapes from the cell in a state of living development. The lashes begin thrashing the water, thus setting the ball revolving about its own axis. In this manner it travels thru the water animated with life which seems to change this plant into a lively little animal. At the expiration of a few hours this motion ceases, whereupon the ball lodges in some convenient nook or cranny, draws the lashes in and slowly grows into a thread algae.

The plant and animal kingdoms merge imperceptibly into one another, so that it often happens that plants are confused

(*Continued on page* 570)

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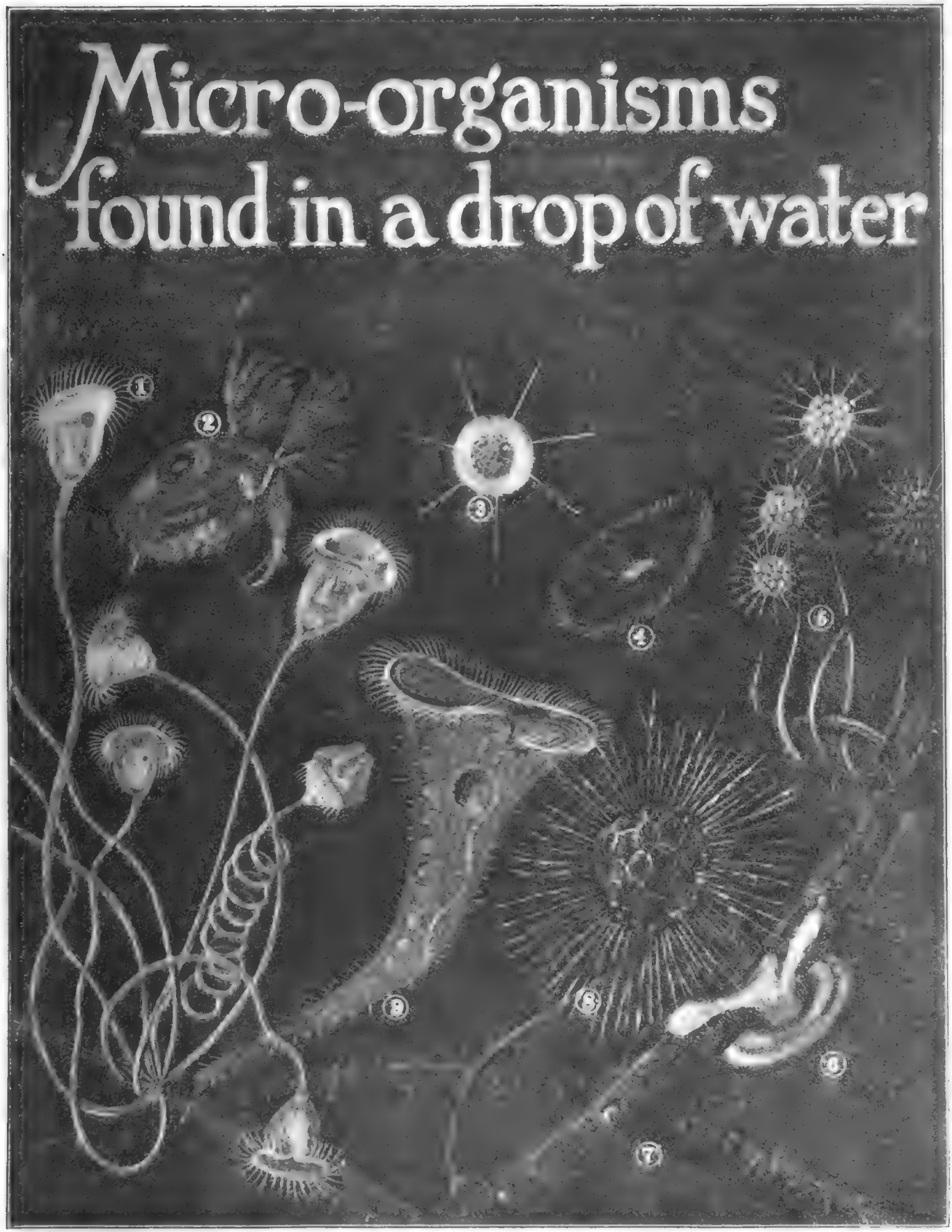
Micro-organisms found in a drop of water



1—A Small Colony of Vorticella which has Attached Itself to a Green Algae. These are Glassy-White Ciliated Animals.

2—Bosnia Is a Small Flesh Colored Crustacean, it Beats the Water with the Feathery Branched Arms. This Animal, as well as Its Relatives, are the Main Food Supply for the Young Fish.

3—Pompholyxophrys Is a Spherical Animal with Radiating Rays which are Pseudopodia.

4—The Paramecium, or Slipper Animal, is One of the Most Common of all the Infusorial Organisms.

5—Anthophysa Is a Stalked Colony-Forming, Ciliated Animal. The Individual Animals are Situated on the Top of the Stalk, and about Sixty are Sometimes Found Bunched Together.

6—Arcella Is a Brown Colored Fungus-Like Root-Footed Animacula.

7—The Green Thread-Like Algae are Always Found in the Waters Infested with These Animals.

8—Clathrulina; the Skeleton of this Organism is Situated on a Stalk and Sends Out Pseudopodia.

9—Stentor Is a Comparatively Large Funnel Shaped Animal. A Large Number of Cilia are Situated not Only on its Circumference, but Over Most of its Outer Surface.

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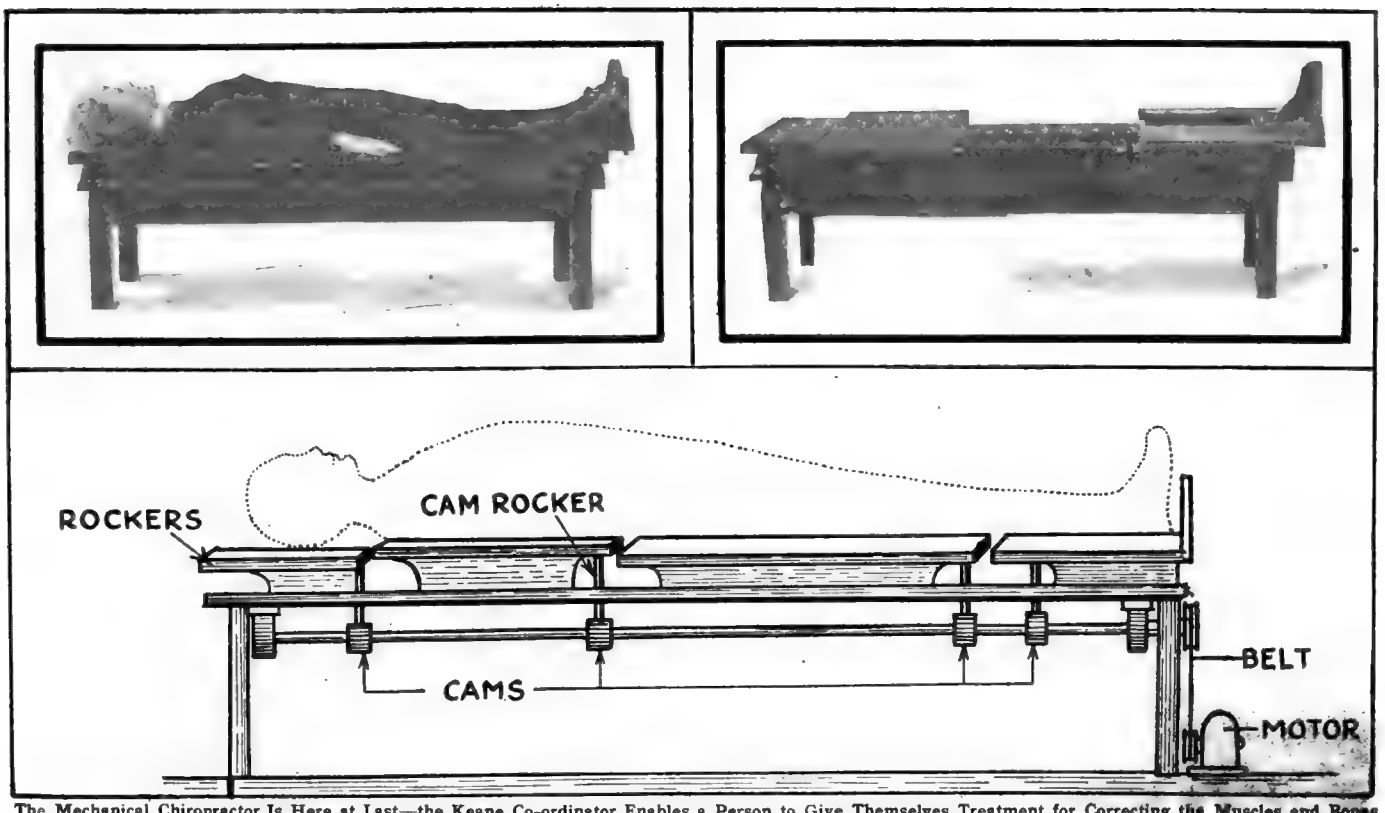
A Mechanical Chiropractor

By BYRD MOCK



The Mechanical Chiropractor Is Here at Last—the Keane Co-ordinator Enables a Person to Give Themselves Treatment for Correcting the Muscles and Bones of the Body—as the Illustration Clearly Demonstrates. Each Section of the Table can be Oscillated a Different Amount as Required. Two Co-ordinators at Top are Manually Operated—One at Bottom Is Electrically Operated.

IN the May issue of *Science and Invention*, Jay G. Hobson, who writes entertainingly on scientific subjects to invent, suggested that some genius might invent *A Mechanical Chiropractor*. No sooner said than done. In fact it was done before Mr. Hobson even suggested it, tho the news had not been made public.

The man who dreamed it all out and patented it is George Arthur Keane, of New York City.

In speaking of Chiropractic, Mr. Hobson said that its discovery was the start of the greatest profession known in the art of healing humanity. Comes now this invention which will enable every man to become his own chiropractor, as the mechanical chiropractor adjusts the entire spinal column by gently oscillating the vetebrae, and relaxing the surrounding tissue, so that a normal flow of nerve fluid is established thruout the entire body, giving health and greater efficiency.

There is a separate rockable section for the head, shoulders, hips and feet. In operation, the person lies upon the device and the three sections, the hip, leg and shoulder section, are fastened so as to allow only the head section to be moved. Or the head and shoulder sections can be locked, so as to allow only the hip or foot section to be rocked or swayed.

In order to adjust the device for a child, there are sufficient locks in the supporting base so that one of the sections can be omitted, and the three lower sections used.

The co-ordinator is effective in inducing in the occupant the control of any part of the body by the mind, or in other words, perfect co-ordination.

Both the manually operated co-ordinators and the motor-driven type are shown in the illustration, as well as the arrangement of the patient on the device. The cams on the shaft driven by the motor can be changed at will, for treating different ailments.

New Heart-Beat Recorder

Dr. Harvey R. Foote, a Park Lane specialist, of London, England, recently gave a demonstration in that city of a new instrument designed to register the action of the heart. Rubber tubes are attached to the wrist, neck and the region over the heart, and these actuate a device which inscribes upon a moving strip of paper three lines, from the form of which the physician is able to learn the action of the heart, as transmitted by the arteries to each of these places.

Dr. Foote's instrument is known as the "Polyograph" and its indications would seem to approximate quite closely to the results given by the expensive and bulky electro-cardiograph apparatus. The Polyograph, as will be seen, records the heart action from approximately the same points on the body as does the electro-cardiograph. The acoustic or sound vibrations are transmitted thru the rubber tubes and impinge on the diaframs of three tambours or drums. The recording styluses are connected to these tambour diaframs and are vibrated by them in correspondence with the heart beats.

To Use This Heart-Beat Recorder, Rubber Tubes are Attached to the Wrist, Neck and the Region Over the Heart. The Sounds from Each Point are Caused to Act on Diaframs which Actuate the Recording Needles.

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The "One-Man" Alarm Clock

Some sleepers, who are addicted to missing their morning train and appearing on the scene of war—er work, a half hour late, sometimes with sad results, will be interested in the "individual" alarm clock we illustrate. A loud ringing alarm clock, which is liable to awaken everyone in the neighborhood except its proprietor, often constitutes a real nuisance. A more moderate clock may be made still further inocuous, by having its alarm bell enclosed in a little hood, which by a flexible tube connects two ear-pieces, which the heavy sleeper attaches to his ears on retiring. When the clock goes off at 5:00 a.m., the sound sleeper gets individual treatment.

Of course, it may fail to operate, and our artist gives two suggestions for waking such a sleeper. The one is the family slipper, applied by the willing arm of the "lady of the house." At any rate we imagine the average sleeper will awake with the impression that a couple of pneumatic riveting guns are saluting his ears.

The Individual Alarm Clock Is the Latest—We Hope Pa Awakes Before Ma Whales Him

Church Hymns by Radio

Church hymns by wireless telephone became a reality recently, when the musical service at the Calvary Church of Pittsburgh, Pa., was sent out via the experimental radio station of the Westinghouse Company at East Pittsburgh. A private telephone line was installed between the church and East Pittsburgh, and the music collected in transmitters at the Calvary Church and transmitted over this line. It was then amplified and sent out over the radio telephone, making it possible for persons, having wireless receiving sets, within several hundred miles of Pittsburgh to hear the hymns. The choir music consisted of forty-five voices, a boy choir which, with the organ, blended to make inspiring music.

Firemen Now Have Telephones

We illustrate herewith, a fireman rescuer in full panoply; on his back are his oxygen gas cylinders so that he is free from dangerous asphyxiation, his helmet and head appurtenances enabling him to cut off asphyxiating air and to breathe from his own supply. He also carries a telephone receiver and transmitter connected by wire with the outside world, so that he can summon help, or direct placing of the water streams and summon assistance if required. It is, by such manoeuvres as these, that life may be saved, and a water screen properly directed may preserve an inmate of a house from death by fire. We have not yet attained such a degree of civilization as would make conflagrations impossible. It is doubtful if this generation or the next will ever see fireproof buildings extensively erected. So the best we can do under the circumstances is to provide the best apparatus and, where the question of life-saving comes in, to equip our rescuing force, so that the members of it will be protected from injury while engaged in their heroic occupation.

A Fire Department Rescuer Equipt With Full Telephone Equipment Enabling Him to Connect It Any Time With the Fire Fighting Force.

A Novel Phonograph Cabinet

We take pleasure in illustrating a very beautiful phonograph case constructed of solid mahogany and hand carved, which was made as a present to Mr. E. P. Morse, Sr. It was presented to him as a surprise by the joiner shop at his shipyard. While several of the joiners had a hand in making this beautiful case, the foreman, Fred Daddi, who designed it, personally did considerable of the work upon it. The photographs tell the story better than anything that we could say. The case certainly reflects credit on the designer and the workmen who executed and carried to a finish this beautiful idea. We are indebted to the courtesy of the Morse Dry Dock & Repair Co., Brooklyn, N. Y., for the use of these illustrations.

The Solid Mahogany Phonograph Case Closed for Playing and Opened for Inserting the Record. This Elegant Cabinet Was Recently Presented by the Joiners of the Morse Dry Dock and Repair Co., of Brooklyn, N. Y., to Mr. E. P. Morse, Sr. The Design Is Quite Unique and With the Hand Carving All so Well Carried Out, Has Produced a Very Beautiful Piece of Furniture

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Metal Phonograph Records

By Dr. HARRY A. KNAUSS, M.D.

(THEIR INVENTOR)

I HAVE been occupied for over one year on the design and perfection of a playing commercial phonograph record, double disc, made entirely of metal. I have now succeeded in producing this article, samples of which I have successfully demonstrated to the editors. There are certain terms in the phonograph record which will illustrate more clearly than anything else the problems involved in the production of records.

First of these is, "surface." As nearly everyone knows, there is a tremendous weight concentrated on the small area of the needle point. The material carrying the groove which has to sustain this weight and yet track smoothly must be smooth and tough, and should be unbreakable. Heretofore, the nearest approach to these qualities was found in a mixture of shellac, rottenstone, graphite and paper floc, known to the industry as "stock." This mixture, when heated and pressed with dies while warm, takes the impression of the sound grooves from the metal "stampers." These metal stampers are made by electro-deposition of copper, the surface of which is subsequently plated with a very thin coat of nickel. This gives the printing or stamping surface. It is seen that the present method becomes a printing or stamping operation after the proper dies are made.

In the process of making the indestructible metal record, which I have named the Duramel Disc, I carry the electro-deposition several steps further. It is well known that playing records have been made out of copper since the inception of the industry. However, these would not hold up for more than six or eight playings, at most, because the copper soon began to spin under the tremendous weight and the tool action of the sharp needle. Therefore, I first obtained a hard surface by plating an alloy of hard metal directly against the model. This shell is then backed up by electro-deposited copper, as shown in the illustrations. We have, then, a single-faced record, the grooves and playing surface of which *must* be absolutely accurate reproductions, because they are deposited with molecular accuracy.

But it became immediately apparent, in the course of my research that no *single* piece of metal would remain flat under the weight of the heavy tone arm of the phonograph. The single sheet of metal would invariably curl and buckle. Of course this led me to the making of double disc records by placing the single ones "back to back."

After some experimentation, I found that the only thing which would properly hold the two pieces of thin metal together is tin. The front or playing surface is properly protected, the back surface is properly cleaned, and the two shells are then fitted back to back under pressure and heat. I have designed a special device for making this a simple mechanical operation which can be done by almost anyone with proper instruction. The device illustrated can be used to put together two hundred or more at a time.

One of the first questions asked by the practical phonograph man is, "Where are you going to get enough models and get them quickly enough to deposit the metal records?" Suffice it to say that this is one of the things which makes the process commercial, and it is entirely solved. By means of a pressing operation in soft metal, illustrated in the diagrams, it is possible to turn out twelve thousand metal forms a day from two dies and one large press. On these forms are deposited twelve thousand halves of six thousand whole records in a period of three hours following their being placed in the electrolytic bath.

Thus twelve thousand halves are stript from their models at the end of three

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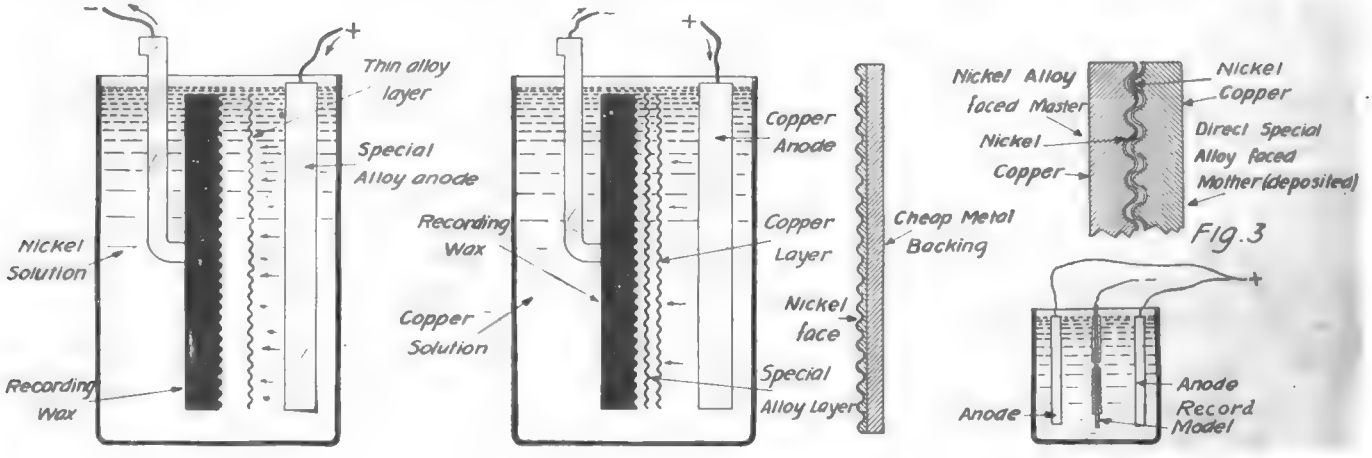

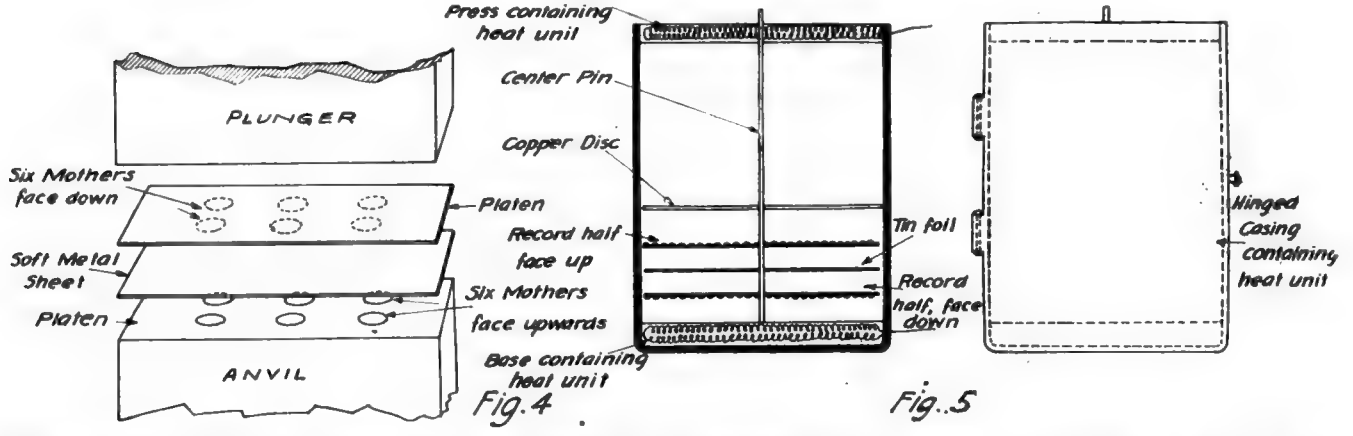

The Author of the Present Article has Developed a New Process for Making Metal Phonograph Records on a Commercial Scale, Which are Both Lighter and Cheaper Than the Present Records and Moreover, They Play with Practically no Scratching and with Infinitesimal Wear. The Successive Stages in Making the Knauss Metal Phonograph Record, are Shown Above, and Those Familiar with Electroplating Will at Once See How the Problem Has Been Solved. The First or Master Record, Recorded in Wax, Is Made Suitably Conducting by Coating with Powdered Grafite. A Special Alloy Deposition Is First Made on the Wax. Fig. 2—How the Special Alloy Record Is Re-enforced with a Copper Deposit in a Copper Sulfate Bath. Fig. 3—Nickel Alloy Faced "Master" Record, Placed in Special Alloy Bath and Thus a Direct Special Alloy Faced "Mother" Record Is Deposited. Fig. 4 Shows a Scheme for Impressing Six Records on Top and Bottom of Lead Sheet, Which Is Afterward Placed in a Plating Solution and the Record Faces Deposited Thereon. Fig. 5 Shows an Electric Heater for Sweating Two Metal Record Faces Back to Back to Form a Complete Two Faced Record.

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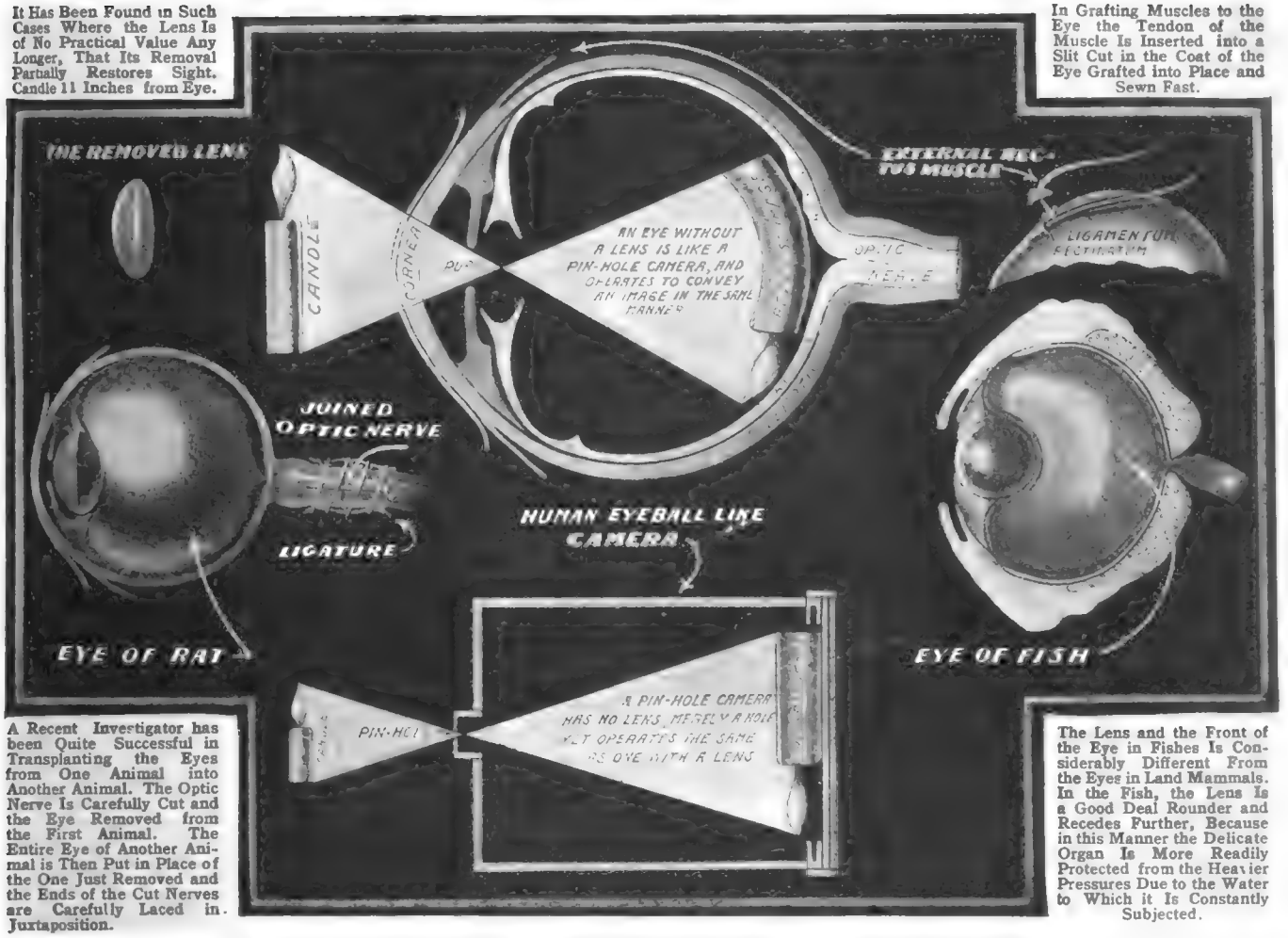
Can Human Eyes be Transplanted?

By WILLIAM M. BUTTERFIELD

It Has Been Found in Such Cases Where the Lens Is of No Practical Value Any Longer, That Its Removal Partially Restores Sight. Candle 11 Inches from Eye.

In Grafting Muscles to the Eye the Tendon of the Muscle Is Inserted into a Slit Cut in the Coat of the Eye Grafted into Place and Sewn Fast.


THE REMOVED LENS
CANDLE
CORNEA
AN EYE WITHOUT A LENS IS LIKE A PIN-HOLE CAMERA, AND OPERATES TO CONVEY AN IMAGE IN THE SAME MANNER
OPTIC NERVE
EXTERNAL RECTUS MUSCLE
LIGAMENTUM PECTINATUM
JOINED OPTIC NERVE
LIGATURE
HUMAN EYEBALL LIKE CAMERA
EYE OF RAT
EYE OF FISH
A PIN-HOLE CAMERA HAS NO LENS, MERELY A HOLE YET OPERATES THE SAME AS ONE WITH A LENS
PIN-HOLE

A Recent Investigator has been Quite Successful in Transplanting the Eyes from One Animal into Another Animal. The Optic Nerve Is Carefully Cut and the Eye Removed from the First Animal. The Entire Eye of Another Animal is Then Put in Place of the One Just Removed and the Ends of the Cut Nerves are Carefully Laced in Juxtaposition.

The Lens and the Front of the Eye in Fishes Is Considerably Different From the Eyes in Land Mammals. In the Fish, the Lens Is a Good Deal Rounder and Recedes Further, Because in this Manner the Delicate Organ Is More Readily Protected from the Heavier Pressures Due to the Water to Which it Is Constantly Subjected.

RECENT investigations at the Physiological Institute, Vienna, carrying out the discoveries of a young Hungarian, Theodore Koppanyi, under the assistance and supervision of Professor Kolmer, should interest everyone afflicted with any of the many forms of eye trouble. Even tho these investigators have only been successful in transplanting eyes in fish, frogs and rats, these successes lead us to hope that it may be possible at some time to transplant human eyes as a means of restoring lost sight.

If doubt exists in medical circles, as to whether the animals really do see with their transplanted visual organs, we can only say they show every evidence of being able to see, which is about the only definite proof which a medical man can have that one of his dumb patients has the power of vision.

Certain fish or frogs that resort to protective coloration, that is, change their color at will to conform with their surroundings to protect them or aid them in obtaining food, are among the kinds operated upon. When such animals become blind they cannot see their surroundings, and of course do not resort to protective color changes. When eyes are transplanted to an animal of this kind they do change color, also respond to or avoid light in a manner similar to animals with normal, original sight.

Proof with rats is more difficult, yet they seem to use their transplanted eyes in a normal, original way, jumping over holes, springing about in their cages and so on. The pupils of the transplanted eyes respond to light, and to darkness, and the eyes are as bright and life-like as the eyes of any rodent. The next experiments on the higher animals will be with rabbits, and possibly later with monkeys.

At first this work was carried on with little success for a stitching of silk was used that killed the nerve fibres. Now eyes are transplanted from a freshly killed animal to a living one without stitching—the nerve-ends merely being carefully adjusted to each other. The eyelids are then closed and kept closed for one day, at the end of which the cut nerve ends have united. In three or four weeks the eyes respond and sight is restored.

The nerves that are thus united constitute the only troublesome feature of eye replacement. These are outlined in the drawings that accompany this article. In looking at these let us first consider the eye ball; it is a hollow ball-like structure having an opening at one end in which is inserted the lens system. The opposite end is lined with inter-lacing fibers that are brought together at a central point, where they are grouped longitudinally and pass out of the eyeball in a stem-like mass called the *optic nerve*. It is this stem that is cut, joined and united in the eye-transplanting process. The eyeballs are merely inserted in the emptied eye-sockets, much as a glass or artificial eye is introduced in the empty socket of a soldier.

During the recent World War, nerve stretching and union of the broken ends of shattered nerves was resorted to quite frequently, and many a contestant who would otherwise have been incapacitated, must thank modern surgery for the recovery of the use of his limbs.

Another rather strange report vouched for by the medical experts, is the fact that a movable artificial eye may be inserted into the eye socket of a person who has lost one of his eyes. This artificial eye is identical in color with the real eye and moves in the same planes. The way this was done, was to remove a piece of cartilage from the rib of the patient. To this was fastened the front of a glass eye. The defective eye was then removed and the muscular tendons were rigidly sewed to the cartilagenous mass in their respective positions. This glass covered piece of cartilage was then allowed to settle in the socket. If the movements of the eye thus formed did not correspond with the movements of the real eye, it was again removed from the socket and the defective muscles were tightened up, while those on the opposite side were partially weakened by cutting. Finally, the investigators claimed that they were able to produce an artificial eye which could not be told from the real eye except by the patient himself, who of course, could not see out of the same. Muscles attach themselves readily to cartilage but not to glass, and owing to the fact that this cartilage is fed by the regular blood streams, no septic condition resulted.

(*Continued on page 576*)

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Fortunes From Little Things

By CHARLES FREDERICK CARTER

No. 5
Millions for Noise

AMERICA'S favorite outdoor sport is to sneak up in an automobile behind unsuspecting pedestrians and toot a Klaxon at them to see them jump. It isn't at all surprising that they jump, considering that the Klaxon was the only thing the collective ingenuity of allied mankind could devise that would make a noise loud enough to be heard above the roar of battle in the World War. The Klaxon was used in the trenches to give warning of gas attacks; tho as between the demoniac clamor of a Klaxon and German gas, nervous men probably would have preferred the latter.

Few minor inventions have made such a remarkable record as this electric-warning horn. The instrument itself has never been at all backward about speaking up in its own behalf. In addition to that the inventor devoted to advertising one-half the royalty of $3.00 each that he received. This calls to mind the interesting fact that every one of the simple, every-day devices described in this series of articles, which have made fortunes for their inventors and others, have been advertised lavishly in season and out of season.

Another interesting point developed in detailing the history of these successful devices is that in every instance the inventors have prepared themselves for their work. They found out what they needed to accomplish, what others had done in the same line and precisely why they failed. Nothing could be more absurd than the popular fallacy that great inventions are the result of accidental inspiration.

The Klaxon is the invention of Dr. Miller Reese Hutchison, E.E., Ph.D., member of ever so many scientific associations in America and Europe. Altho he is only 45 years old, he has achieved an international reputation as a scientist, inventor and business man. No fewer than 500 patents have been issued to him up to date. Of these some 25 are basic patents under which commerical articles have been manufactured on a large scale. The others are for improvements on basic patents or are being held for future development.

Articles of a gross value of $50,000,000 had been manufactured under Dr. Hutchison's patents up to January 1, 1921, of which approximately $10,000,000 was net profits. All this was done on an aggregate capitalization of $3,000,000. Now note how the inventor prepared for his life work.

At the age of seven he began attending private school in Mobile, Ala., where his father was a successful wholesale grain merchant. Followed next terms in military school and college. At the age of 11 he selected the profession of electrical engineering for his life work. A year later he decided that he would become chief engineer for Thomas A. Edison, whose remarkable achievements had fired his boyish imagination. He did not tell Edison what he intended to do, which wasn't exactly fair, because it gave the famous inventor no chance to defend himself. The result was that 24 years later Dr. Hutchison actually did become Edison's Chief Engineer and personal representative, exactly as he had planned at the age of 12. What is more, he held that responsible position for six years.

Dr. Hutchison took a special course in electrical and mechanical engineering and design at Alabama Polytechnic Institute, at the same time serving apprenticeships in foundry, pattern, and machine shops. The cap sheaf on his education was a course in anatomy, including dissection, at Alabama Medical College.

Anatomy and electrical engineering dovetailed perfectly in enabling Dr. Hutchison to perfect his first invention, the acousticon, at the age of 19. He produced the acousticon to enable a deaf friend to hear. It worked so well that it was developed commercially, bringing relief to thousands of the deaf and a gold medal for the inventor from Queen Alexandra.

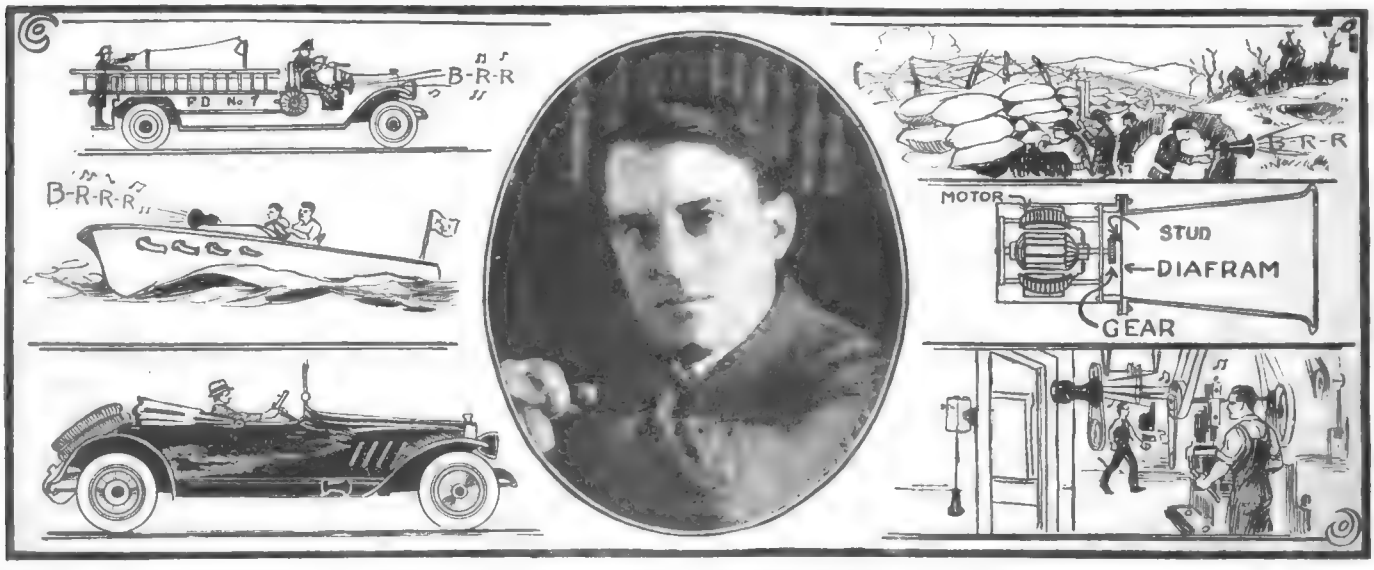
The acousticon suggested the Klaxon some fourteen years later, as something to take the place of the numerous fantastic, unsuitable devices then in use as warning signals for automobiles. It fulfilled that mission so well that it is now in use on autos all over the world. Approximately half the automobiles in the United States are equipt with Klaxons. It is also used on motor boats, on fire apparatus and for signaling in noisy factories.

Klaxons are made in various sizes and shapes according to the place they are to occupy and the purpose they are to serve; but the essential feature has never been changed because nothing worse than the diabolical noise it produces could be made by mortal. And by the way, never call the Klaxon a "horn;" it isn't a "horn." It is a noise producing machine; Dr. Hutchison says it is, and no one who ever heard it would presume to dispute his dictum.

The original Klaxon was operated by electricity; but later a mechanically operated one was also placed on the market; the smaller one being actuated by pressure on a plunger, the larger ones, such as are used on fire apparatus and in the trenches during the war, by a crank, hence the doughboys called 'em "coffee mills."

The mechanism consists of a miniature motor of excellent construction set vertically in a casing, the axle running on steel balls in a bushed bearing. On top of the vertical shaft is a wheel an inch in diameter with 10 teeth or ratchets of specially hardened steel. These teeth strike against a button on the center of a diafram 5½ inches in diameter of specially prepared steel, secured at the circumference by six bolts with cork washers. As the motor makes 3,000 revolutions per minute the teeth on the ratchet wheel keep chewing on that hard steel button at the rate of 500 bites per second, or 30,000 per minute. Naturally the diafram protests against such treatment with an awful roar, such as never was heard before, and, it is to be hoped, never will be heard again. Fortunately the thing is adjustable so that humane automobilists can mitigate the horrors of their Klaxons to some extent.

The Klaxon is self-contained. The diafram shuts off the motor from the outside atmosphere. Wiring connections are made by specially arranged binding posts. No particle of dust, dirt or moisture can get in. The motor casing is of mild iron. The brush holders are arranged to take up wear automatically. The brushes are copper gauze charged with grafite so as to be self-lubricating. Energy is supplied the Klaxon by 6 to 8 dry batteries, or else it is operated from the storage battery.



"Millions for Noise," Is Right, as Mr. Carter Well Puts it. Dr. Hutchison's Klaxons Have Been Used for All Sorts of Alarms, on Motor Cars, Motor Boats, Fire Trucks, Gas Signals in the Trenches, Telephone and Special Signal Alarms in Noisy Factories, et cetera. This Idea and the Tremendous Sale the Device Has Had, Demonstrates Vividly Just How a Simple Yet Good Invention Will Go "Over the Top." The Klaxon Comprises Nothing but a Small Battery Motor Having a Gear Wheel Affixed on the End of the Shaft, the Teeth of This Gear Striking Against a Steel Stud Fastened to the Diafram of the Horn.

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A Skipping Boat

$50.00 Prize Contest

EVERY boy at one time or another has tried the skipping stone experiment. He takes a flat stone and throws it, giving it a revolving effect and lets go of it suddenly. The surface of the stone should be parallel with the surface of the water; then when the stone strikes the water it will skip along, performing several skips, all depending how violently the stone has been thrown.

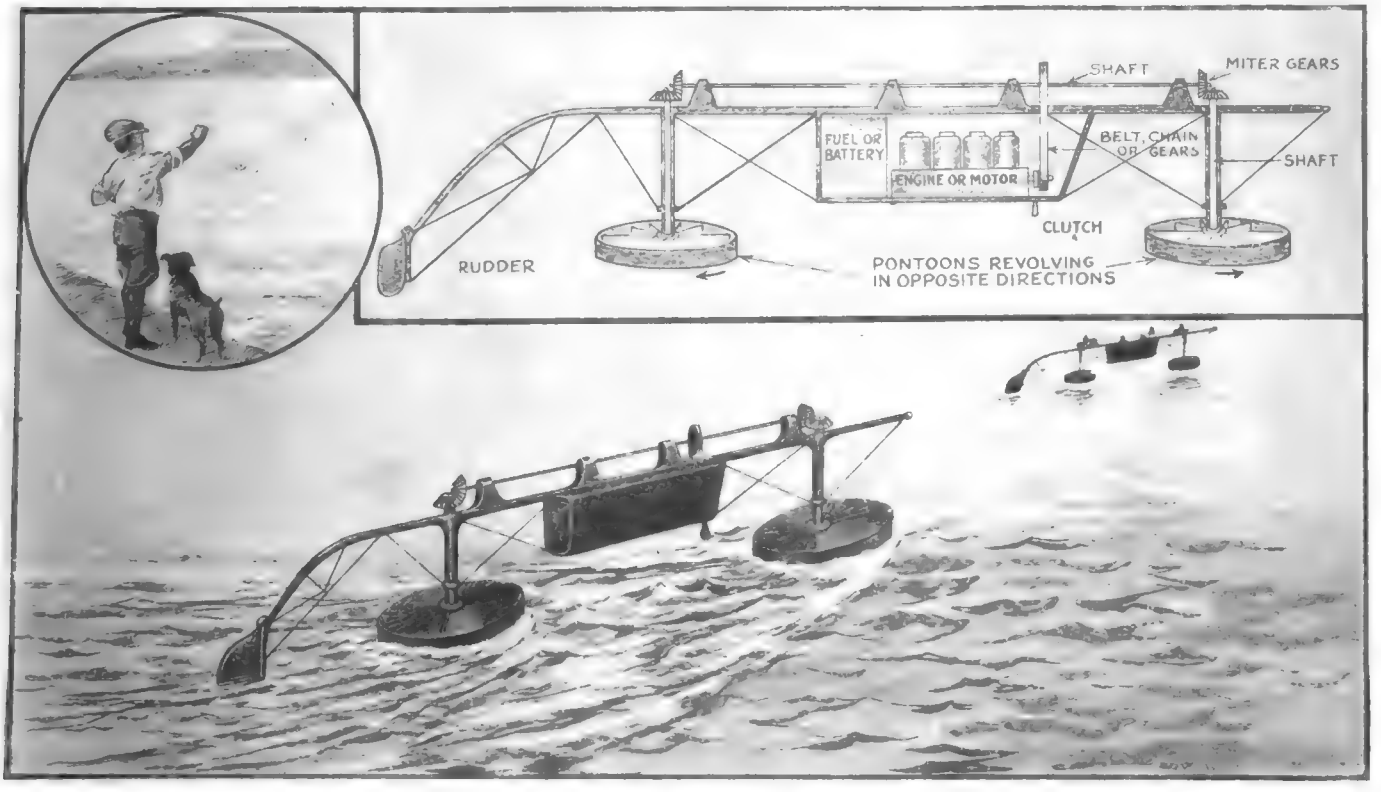
In our illustration we are showing a machine *that is supposed* to skip over the water exactly as a stone skips. The idea occurred to us not so long ago and no sooner had we evolved it than we immediately had strenuous objections against it. In the first place, a machine is not a stone. Secondly, you cannot take a machine and hurl it over a lake or body of water as you can do with a stone. In other words, it will be difficult to give the machine its initial velocity. Just the same if such a machine is constructed correctly and if the power is sufficiently strong, perhaps after the machine has acquired sufficient momentum, it would begin skipping. Anyway, who knows?

We shall pay three prizes, one of $25, one of $15, and one of $10—to the constructors who build the best models. Contest closes November 20th. If two contestants should send in exactly similar explanations, and have built identical models, thus forming a tie, a similar prize will be paid to each. It matters not whether the model actually skips or not. With the photograph of the model should be given a good explanation why the device works or why it does not; 200 words are sufficient.

Address all photographs and manuscripts to the Prize Contests to EDITOR SKIPPING BOAT CONTEST.

And if it does we will have a brand new sensation skipping over the water, similar to a flying fish. The main thing is, will the machine work or won't it? The editors have discust the matter pro and con and have not come to any satisfactory conclusion. The inventor of the machine says it will skip, altho he would not wager much money on his conviction. The others claim that it will not only not skip, but that it will not move, either.

In any event, we feel that we are in a tight corner so we are putting the whole thing up to our readers. Discussions pro and con will not be convincing. What the Editors desire is nothing short of a model, small or large. If a small model, its "motor" may be of the rubber band type, as used on model airplanes, or a good spring motor may be used. Who will be the first to build an actual model to demonstrate, if the theory is correct or wrong?



Do You Think that a Skipping Boat, Built Like the Design Here Illustrated, can Actually Skip Over the Water? Build a Model, Try It Out, and Write a Short, Concise Article Describing its Merits and Faults, if You Believe Them to be Faults; Send it and a Good Clear Photo of the Model to the Editor of the Skipping Boat Contest, as Explained above in Detail. Contest Closes Next November 20th.

What Radium Looks Like

Radium is a metal, and is described as having a white metallic luster. It has been isolated only once or twice, and few people have seen it. Radium is ordinarily obtained from its ores in the form of sulphate, chloride, or bromide, and it is in the form of these salts that it is usually sold and used. These are all white or nearly white substances, whose appearance is no more remarkable, than that of common salt or baking powder. Ordinarily radium ore carries only a small fraction of a grain per ton of material, and radium will never be found in large masses because it is formed by the decay of uranium, a process which is exceedingly slow, and radium itself decays and changes to other elements so that it is impossible for it to accumulate naturally. Radium and radium materials are not generally luminescent of themselves. Tubes containing radium glow from impurities present which the radiations from the radium cause to give light.

When radium is combined in minute quantity with zinc sulphid and other salts, it forms an undark substance that is used for watch dials, electric light locator buttons, luminous gauges for automobiles, etc.

Minerals that carry radium are fairly easy to detect for they affect photographic films in the same way as ordinary light, and they can also be identified by their effect upon an electroscope.

In Paradox Valley, Colorado, there are the Undark carnotite mines. Here is dug from the earth the ore from which radium is extracted. It is loaded on wagons drawn by six-horse teams and carted fifty-eight miles to the nearest railway. This takes three and a half days. It is then loaded on freight cars and shipped east to Orange, New Jersey. It takes eight car loads to transport two hundred and fifty tons, and it takes the entire two hundred and fifty tons of carnotite ore to produce one gram of radium and a gram is less than a thimble full. Hundreds of reduction processes are necessary before the radium is finally produced. This gram of radium is then combined with twenty thousand grams of phosphorescent zinc sulfid, and it is not until then that the radium luminous material is ready for the market.

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MOTOR HINTS

First Prize, $25.00

A COMBINATION LOCK SWITCH

A disk of bakelite or similar material about 1½" in diameter and ½" thick contains a hermetically sealed space holding a small quantity of mercury. This disk projects a slight distance from the dash. By properly turning it about its axis the mercury comes to rest in two pockets, and thereby closes the circuit. A turn of ninety degrees or more empties the mercury from the pockets and the circuit is open again. An almost infinite number of trials would be necessary to get the mercury divided again into the proper proportions and back into the pockets. But the ease with which this may be done, if the necessary move be known is illustrated by the following sample set of instructions:

First—Turn the disk to right till the mark is at the top. (See Fig. 1.)

Second—Turn the disk three clicks farther. (See Fig. 2.)

Third—Turn disk five clicks to left. Circuit is now closed. (See Fig. 3.)

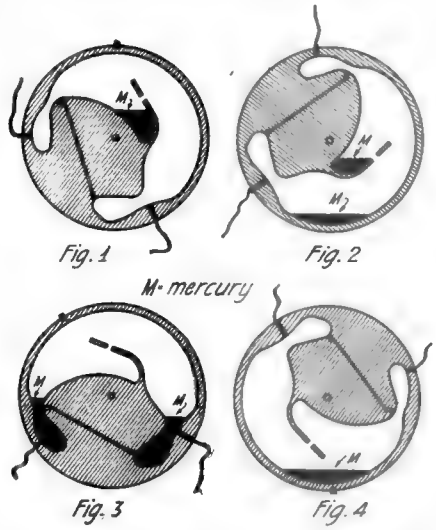
To Open Circuit Upon Leaving Car—Give the disk a good turn—ninety degrees or more. (See Fig. 4.)

The following advantages are apparent: 1—No key to carry or lose. 2—Construction is one solid piece not possible to derange except by breaking. 3—An endless number of designs can be made by slight changes in shape of interior space. The combination can also be varied by changing position of mark on margin of the disk. 4—Low cost of manufacture. 5—As easily worked in dark as in daylight. 6—The combination cannot be solved by sound. 7—The combination cannot be solved by throwing in the starter switch and slowly turning the disk. Certain back and forth movements of the disk are absolutely necessary. 8—To solve the combination by trial is practically impossible.

Provision is easily made in designing so as to guard against possibility of mercury being thrown out of contact with the conductors by tipping of the car sideways. In exceptionally extreme cases of tipping sideways the disk could be turned in the proper direction to compensate. This would be a rare contingency. Tipping of the car forwards or backwards would not matter. Provision also requires to be made against jolting of mercury out of the pockets. There are various simple ways to do this that anyone can think of. The best must be learnt by experimenting; the necks of the pockets could be made narrow.

The device has the advantage that there is no difficult combination to remember. In the above example, for instance, one would need to bear in mind simply the number "35." If desired, additional security could be had by putting the numbers 1 to 9 on the margin of the disk and using one of these instead of the mark. There would then be three numbers in the combination to remember. By making the numbers on the disk so that they could be distinguished by touch, the device could be worked in the dark.

Contributed by G. S. SCOTT.



A Secret Mercury Switch Which Can be Mounted on the Dash or Elsewhere, and Which It Is Almost Impossible for Anyone, Except the Owner of the Car, to Properly Set, so That the Contacts are Short-Circuited and the Ignition or Other Circuit Properly Closed.

Second Prize, $15.00

MERCURY CUP ALARM

The principal parts are two mercury cups with adjustable electrodes for adjusting the sensitiveness of the contact. One of these is adjusted so that if any one just steps on the car or tries to take a tire from the car it would give a contact, closing circuit to the relay, which in turn would stay in the closed position thru the locking contact until owner opened circuit thru switch.

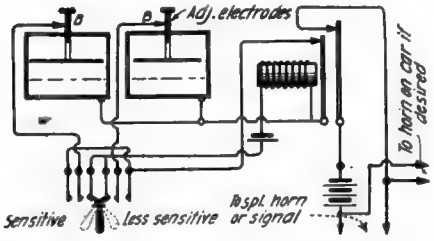
The other adjustment is less sensitive so that the thief could get into the car, but upon trying to start the motor it would close the circuit as before described.

When the relay is energized it closes the circuit to a special signal and also to horn on car, if desired. These continue to operate until the owner opens switch.

The switch is not located in the same place on any two cars. There are many inconspicuous places on a car to mount the switch.

The mercury cups, relay and dry cell are all mounted in a small case, which is set in under one of the seats or in under the dash.

Contributed by E. W. ANDERSON, JR.



The Principal Parts in This Mercury Cup Automobile Alarm Lie in the Make-up and Adjustment of the Two Electrodes, BB, Which Rest Against the Surface of Mercury in the Two Cups. A Slight Jar Closes the Mercury Cup Contact, Which Closes the Circuit Thru the Relay, and This in Turn Will Stay in the Closed Position Due to the Locking Contact Indicated, Until the Owner Opens the Circuit by Means of the Switch. One of the Mercury Cups Is Adjusted to be Less Sensitive Than the Other, so That the Thief Could Get Into the Car, but Upon Trying to Start the Motor It Would Close the Circuit as Before.

NOTICE—CONTRIBUTORS!!!

We have not been at all satisfied with the class of suggestions we have been receiving lately in this department. Most of the devices that are suggested are very crude, and while some of them may be original, they are so impractical that not one in a hundred motorists would think of using or installing such a device. There is, however, one device that is needed badly which apparently has as yet not been invented. We refer to a device that would prevent stealing of motor cars. In the City of New York alone, there are stolen every day an average of 15 cars. The average for the entire country varies from between two to three hundred cars each and every day. This is a terrible loss and must be stopt at all cost.

For the next few months we will, therefore, give prizes only to such devices as prevent stealing of cars. We have publisht a few good ones in the past, but we feel sure that there are a good many others that should prevent thefts. It should be remembered always that motorists do not wish complicated and cumbersome devices; something that can be put in place quickly, and that can be removed just as quickly, is what is wanted. The device should, of course, always be secret so that the casual crook will not know how it is used. Variations of the device should be possible so that even after publishing such a device and giving it the fullest publicity, still it could be attached in such a way as to defy detection by the average man.—Editor.

FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

Third Prize, $10.00

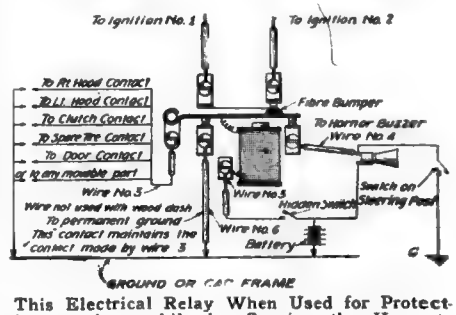
ELECTRICAL RELAY ALARM

An electrical device for preventing the theft of automobiles has been perfected by George MacNeal, of Fenton, Michigan. It consists of a coil and magnet bar, encased in small steel box, which are connected with a hidden switch, the horn, the ignition and any, or several movable parts of the car.

When the owner leaves car he *sets* the switch. When the particular movable part is tampered with, usually this connection is to the clutch, the coil is magnetized and the magnet-bar is drawn over, forming a connection with the horn and shutting off the ignition. The horn will then blow until the switch is turned off.

Before a thief could find it every passerby would be attracted by the noise. A door to a coupe, spare tire, hood, or any other part, or all of them, may be connected to the device. It may also be connected to the floor boards.

Contributed by CHET SHAFER



This Electrical Relay When Used for Protecting an Automobile by Causing the Horn to Sound When the Car Is Tampered with, Is Connected Up in the Manner Shown with a Hidden Switch, etc. When the Owner Leaves the Car He sets the Switch. When any of the Parts Indicated are Tampered with, the Magnet Coil Is Energized, and the Movement of the Armature Closes the Horn Circuit, and Opens the Ignition Circuit.

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Editor's Mail Bag

ATOMIC ENERGY

Editor SCIENCE & INVENTION:

We read much in the newspapers and magazines about the energy residing in the atom; locked up in the atom, etc. Also if we could only unlock this great store of energy, how we could sling battleships over the moon, etc., etc.

I would like to question the logic of such information. If I understand rightly, energy always works in circuits or the equivalent; there is an outlet and an inlet. The visible emanations of radium are not a measure of the energy passing through it, any more than the sparks from hot iron are a measure of the energy used in shaping it.

In motion pictures, we see a whole company come out of an auto, and consider it humorous. The magazines tell us of great quantities of energy coming out of an atom and none going in, and people take it seriously. The case of radium is like that of the magnet; labor or the equivalent is used to make the substance a good pathway for the lines of force coming from the sun. When the ordinary electric current is raised in pressure and frequency new phenomena appear, so with radium. No energy is gained, only potency, all paid for in work or the equal.

The atomic energy bug is only the perpetual motion crank in another guise.

ALVIN MORELLE.

46 Hanson Place,
Brooklyn, N. Y.

(We cannot agree with our correspondent. Compare a piece of dynamite with radium (for illustration's sake). Both, as far as latent energy is concerned are quite similar, except that radium gives off its energy slowly but surely. After millions of years it will have turned into lead. If we could realize all its energy instantaneously it would prove far more powerful than dynamite, weight for weight. But as yet we have not learned how to do it anymore than we can utilize dynamite in a motor for power purposes. In short, dynamite goes off too quickly for us, radium too slowly. But there certainly is no thought of perpetual motion here.

Now radium is only an element just as a piece of copper. Both contain a tremendous amount of latent energy—a one-cent copper piece could haul a train from New York to Chicago—if we knew how to get at the energy.

—EDITOR.)

FROM BAD TO WORSE

Editor SCIENCE & INVENTION:

I have been a steady reader of your magazine and I must say in complaint that your magazine is getting "bummer" all the time. You have left out a number of interesting things that are vital to the keeping up the interest of your readers. The quality and the quantity is decreasing all the time; of course, your magazine is not a technical one, but the people as a majority can get the gist of it. Personally, it is none of my business, but for the welfare of your magazine it ought to be looked into.

LEYNORD R. GRAY.

8 W. Delaware Place,
Chicago.

(Sorry old top, but we don't quite "get" you. What are we leaving out? Advertisements? To be sure we leave them out—along with all other publications, due mainly to the present depression. As for the quality, we somehow must be giving it for our circulation increases month after month. And for the quantity we publish about 15% to 20% more TEXT just now than at any time before. It may not appear so, but it is a fact nevertheless; to be sure we print less pages, but that is due solely to the decrease in advertising pages.

—EDITOR.)

BACK TO 1885

Editor SCIENCE & INVENTION:

On page 1024 of the February 1920 number of SCIENCE & INVENTION, Philip A. Wall receives a third prize of $1.00 for an electrical question answerer.

Now I possess a large one with 36 questions and 36 answers. It is manufactured by a Massachusetts concern and patented in June 2, 1885.

WE invite our readers to use these columns for discussion on all subjects of interest to them. We aim to make this page an exchange place for ideas and invite discussion. As hundreds of letters are received weekly, it is manifestly impossible to publish all of them, and we aim to publish only the more interesting ones. Try to keep your communication within two hundred words, and use only one side of the paper when writing. It is not possible to answer communications addressed to this department by mail due to the great influx of communications received.

—EDITOR.

At the top of the "How-to-Make-It" page, you claim to offer prizes for the most useful practical and original devices. Far from original I should say is 1885.

LAWRENCE LEACH.

Danvers, Mass.

(The editors of this publication are well aware that there are electrical question answerers on the market.

What we aim for in publishing such devices is simplicity and detailed design of the same, enabling other experimenters to produce something similar.

If you know of a device which is being marketed at the present day, which you believe other "dabblers with current" would enjoy making, we would be very pleased to peruse same for publication.

As to the laconic diction, 1885, we would state that a thing can get so old as to be new again, so—there you are.

In addition, we would state that it is the first time anyone has had gumption enough to send in a detailed description of this device, which can be made for fifty cents and is sold for $5.00.—EDITOR.)

A FIVE YEAR READER

Editor SCIENCE & INVENTION:

I have been both a newsstand reader of and a regular subscriber for "SCIENCE & INVENTION" (formerly "Electrical Experimenter") for over five years and wish to congratulate you upon your success in getting the new things and the future possibilities in science before the public.

HOWARD KARG.

14820 Euclid Ave.,
Cleveland, Ohio.

FROM THE PENITENTIARY

Editor SCIENCE & INVENTION:

I must write a few lines which I hope will show that I am making an effort to thank you for the SCIENCE & INVENTION magazines you sent to me. I still have them and I find much pleasure in reading them, and the different subjects help me to forget my present condition. Knowledge can be obtained here as well as at any place, so I am making the best of my misfortune at this time until June 1, 1923. I am much interested in your editorials, it sure is good to read of the things, that have been a mystery to me.

Now Mr. Editor, I had opportunities for education above the eighth grade, but at that time I thought that I knew it all. I now see how ignorant I am and I am striving to make up for what I have missed. In sending me your magazine you do me a great favor and also help me to look forward to a bright future.

OTTO SCHOMBURG.

Southern Illinois Penitentiary,
Menard, Illinois.

WHAT IT DID FOR HIM

Editor SCIENCE & INVENTION:

I would like to tell you briefly what I think of your wonderful magazine and what it has done for me. I have completed two years of my course in Electrical Engineering in Ohio State University, located here in Columbus. For the past two years I have been at the head, or nearly so, of every class I have been in that had anything to do with chemistry, physics, or electricity. I have had physical mechanics, physics of light and sound and the theory and fundamentals of all wave motion. I have had most of the basic principles and operations of D. C. electricity, some of A. C. and all of magnetism, including a study of hysteresis and Steinmetz's constants. In all of these branches and in mathematics, I have been one of the "top", and I can give all of the credit to the knowledge I gained from your magazine. This statement can be verified by investigating my record in the College of Engineering here. I feel that my record in O. S. U. has been an enviable one and *I want the credit to go to the proper source.*

I still have two years in college, but with the help of SCIENCE AND INVENTION and RADIO NEWS, I expect to stand as high in the future as I have in the past. Some day, when I'm a famous (?) electrical engineer, I'll call on you and personally thank you for your great work in making me and hundreds of others like me, appreciate the true value of such a wonderful thing as electricity.

KENNETH WARNER JARVIS.

47 E. 17th Ave.,
Columbus, Ohio.

WORTH A DOLLAR

Editor SCIENCE AND INVENTION:

After reading some of the comments in the Mail Bag department, I thought I would give you my opinion of your magazine.

I prefer to read the magazine just as it is published, a little bit of everything; that's what makes it so interesting and valuable; otherwise if only those articles would be published that appeal to a certain class, the name SCIENCE & INVENTION would not be the proper one. The magazine is a great asset to the nation's experimenters and inventors, and a good investment even if it cost a dollar a copy instead of 25 cents.

JOSEPH PACYK.

Kelley Axe Mfg. Co.,
West Charleston, W. Va.

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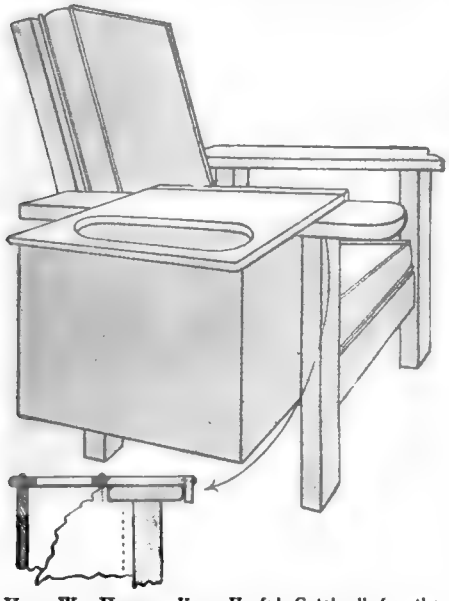
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

CATCH-ALL FOR MORRIS CHAIR

A catch-all that can be made useful for many things used by law-abiding citizens in these bone-dry days, is shown in the cut. It is a box with an oval opening in its top; the top extends across the



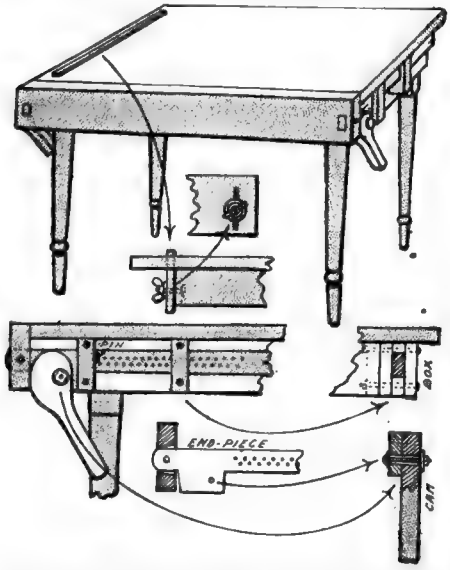
Here We Have a Very Useful Catch-all for the Morris Chair, Which May be Used for Holding Books, a Bottle of Cider, Ma's Sewing Outfit, a Jar of Tobacco, and What Not. The Catch-all Can be Made of Paper Wall-Board or of Thin Wood, While the Top Should be Constructed of Some Substantial Wood, From ¾" to 1" thick. It Should be Sandpapered, Smoothed, and Either Varnished or Painted.

arm of the chair, and is hooked or held in place by a cleat screwed to the inner edge in the manner shown. Besides the uses faintly suggested, the catch-all can be employed to hold books, newspapers, etc. It should be made of wood finished to match the Morris chair of course, and held together with screws that match the metal showing on the chair.

A HANDY CARPENTER'S BENCH

We illustrate a plan for converting an ordinary kitchen table into a handy carpenter's bench, at the same time retaining the table in condition for its ordinary use as a piece of kitchen furniture. A vise arrangement is worked out, in which two cams with handles placed back of the front jaw are made (by pulling forward on the handles) to tilt it backward against the table top or back jaw. The cams and the front jaw are all carried on two sliding end pieces that are retained by grooved runways bolted to the ends of the table as shown.

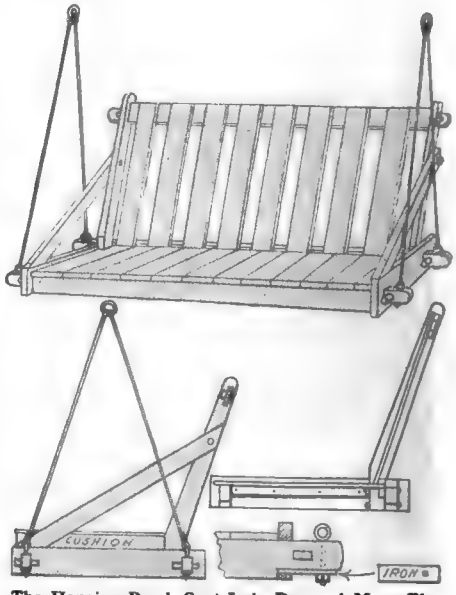
These end pieces have holes bored (see illustration) for iron pins, ¼" in diameter; these retaining pins come against the back of the pockets and form stops to prevent the vise, when adjusted, from being pulled open, as the cams tilt the front jaw to obtain a firm grip. Both ends are alike. The drawings show the construction. A thimble, made of iron pipe, is used to prevent the bolts cutting into the wooden cams (see drawing). The thimbles are tightly held by the end pieces, while the cams move freely on them, the strain of the bolt being against the two ends of the thimbles, not against the side of the cams. A stop for planing is also provided at one end of the table; it consists of a board, pushed up thru a slot made in the table top, and retained with wing nuts and bolts as shown. Adjustment is made when using the vise, first with the sliding bars and pins to within ⅛ inch, when the final grip is obtained with the cams.



Home Carpenter's Work Bench Constructed From an Ordinary Kitchen Table. An Adjustable Stop-Board Is Provided for Holding Material for Planing, While the Clamp Will Hold Stock for Planing or Other Operations.

HANGING PORCH SEAT

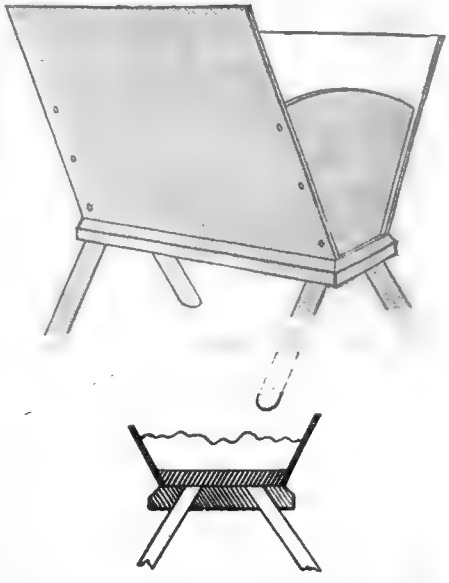
A strong frame is the essential feature in porch seats of the hang-up or swinging variety. We show a construction based on a frame held together by tapered wooden pins, which may be driven into their holes in the tenon ends of the back or seat rails at any time, for the purpose of tightening their hold on these pieces and thereby strengthening the frame. This arrangement is advantageous for the reason that the seat cannot very well creak when in use, if held together in this fashion, and it cannot twist if the tenons fit into the mortises snugly. A piece of 5/16" iron placed under each tenon on the seat rails (in the manner shown) will keep them from wearing. One end of each iron member fits into the bottom of the mortise, and it is retained there; the other is held in place by an eye-bolt holding the chain or wire rope hanger. The drawing shows the railing on the back seat, the arrangements for placing the cleats holding the end and back of the seat and the arm-braces. A cushion, or cushions, may be modeled after those on the home mechanic's Morris chair, and may be covered with leatherette or cloth.



The Hanging Porch Seat Is in Dema d More Than Ever, as Many People do not Like the Old-Fashioned Swinging Hammock.

NEWSPAPER HOLDER

A holder to keep the Sunday papers together, preventing them from mussing up the whole premises, is shown in the illustration. This holder is easily constructed, entirely of wood, or of wood and wall-board—the said wall-board if used, forming the large side pieces. It consists of a bottom piece in which four round legs are set in holes bored at an angle as represented; of end pieces, sides, and a second bottom piece to which the ends and sides are fastened. The legs should have a wide spread and should not be too long, or else the holder, will tip over easily.



A Useful Newspaper- and Magazine-holder, Which Can be Constructed from Paper Wall-board or Thin Wood for the Sides, While the Base and End Members are Constructed of ⅛" stock. It will be Found very Useful in the Library or Reading Room, as well as on the Porch.

IMPORTANT:

TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly every month. If you are interested in receiving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

To.....New

Address.....

Please reserve for me...copies ...CE & INVENTION every month un... you otherwise, and greatly oblige,

Name.....

Address.....

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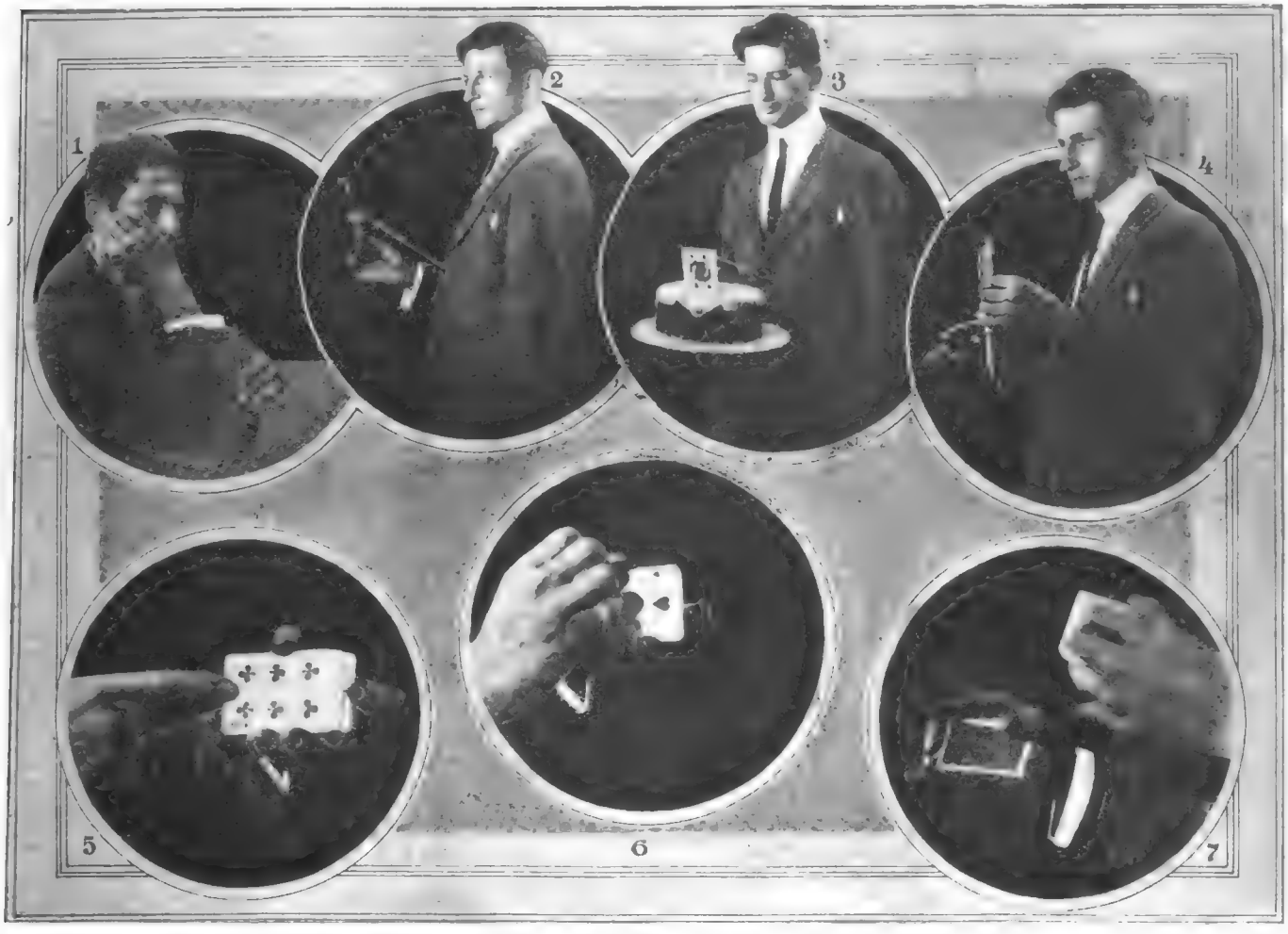
The Amateur Magician

By JOSEPH H. KRAUS

Parlor Tricks Easily Performed

HARGRAVE himself came to the door in answer to my ring. He seemed to have dropt his serious attitude and acted very gleeful as tho he were tickled over something else which he had concealed up his sleeve. "You are just in time," he ventured to say, as I entered, "as I want to show you a new production which I have just completed." "May I make a suggestion?" was my question. "Go right ahead," he answered. "Well, you see, Professor, this series of articles I am writing is being run as the *Amateur Magician* and up to the present time we have had very little amateurish about it. Almost all the tricks described were spectacular stage tricks or those intended for the more professional performer. Now, can't we——"

Hargrave interrupted me here and said, "Tut, tut, old timer, anybody can do those things and make them work and they are just as good for the amateur as for the professional." "Of course," was my rejoinder, "that is understood, but you must realize that many of the readers, altho they do like magic, would not consider entering the field to the extent of building the heavier apparatus, as you call it. Now just for a change, suppose you give us a little parlor magic with which anyone can entertain their folks at home. For instance, tricks with cards or coins." "All right, old top," he replied, "you might get your camera out and snap some of these stunts."



1—How the Coin Is Rubbed Into the Sleeve and Subsequently Found in the Collar. 2—By the Aid of a Blonde Woman's Hair, It Is Easy to Balance a Card on the Hat. 3—The Hair Again Comes to Our Rescue, and Permits the Ring to Slide Up and Down on Command Upon the Pencil. 4—Could You Tell the Color of Three Candles Wrapped in Thick Brown Paper and You to Be Blindfolded While Doing This? 5—The First Stage in Changing the Face of a Card. The Forefinger of the Left Hand Pushes a Few Cards Downward. 6—In the Last Stage the Palmed Cards Are Placed on Top of the Deck and the Movement Followed by a Closing of the Fingers to Make It Appear That the Top Card Is Removed. 7—Second Stage. The Cards Are Pushed Down Far Enough Under Cover of the Hand and Palmed in the Right Hand.

THE THREE COLORED CANDLES

"Now here is a trick," he said, "which any of your amateur readers can construct within ten minutes. Here are three candles, a red, a white, and a blue, and three sheets of opaque paper. I want you to take these candles and wrap them up in the paper, and I will enter blindfolded and will tell you which papers contain the red, which the blue, and which the white."

So saying, he left the room. A moment or so later I beckoned him back and told him that I was ready. Placing a handkerchief across his eyes, I gave him one of the paper wrapt candles. He past his hand up and down along the side rapidly and then said, "That is a blue candle." I marked blue upon the paper and gave him another one. He repeated the operation and said, "That is a red one." I picked up the blue candle again and I gave it to him. Again he said, "This is the same one you gave me a moment ago, the blue candle." He removed the blind from his eyes and we opened the parcels, and sure enough he had named the candles correctly.

"Ah, that's the stuff," I said, not caring whether or not the term "stuff" brought to his mind the meaning behind the phrase. "Now, how does it work?"

"Very simple," he replied, not even forming a complete sentence. "You see each one of those candles contains a small piece of steel which has been magnetized. The blue one contains a piece of steel at the top, the white in the center, and the red at the bottom. Between the index and middle finger of my right hand I hold this small piece of iron and on passing my hand up and down along the candle I feel a slight tug, either at the top, middle or bottom of the candle. This gives me an inkling as to the color within the paper wrapper. Of course I know which is the top and which is the bottom by simply pressing upon the candle and if I feel a sharp edge I know that the bottom is present and if the top is present, the edge will taper toward a point. Now anyone can make this in a few moments."

THE DISAPPEARING COIN

"Now, have you a spare half dollar?" was Prof. Hargrave's next question. "I'd rather you would use one of your own," was my prompt reply. You see Hargrave once borrowed a $5 bill and made it disappear completely.

(Continued on page 546)

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Popular Astronomy

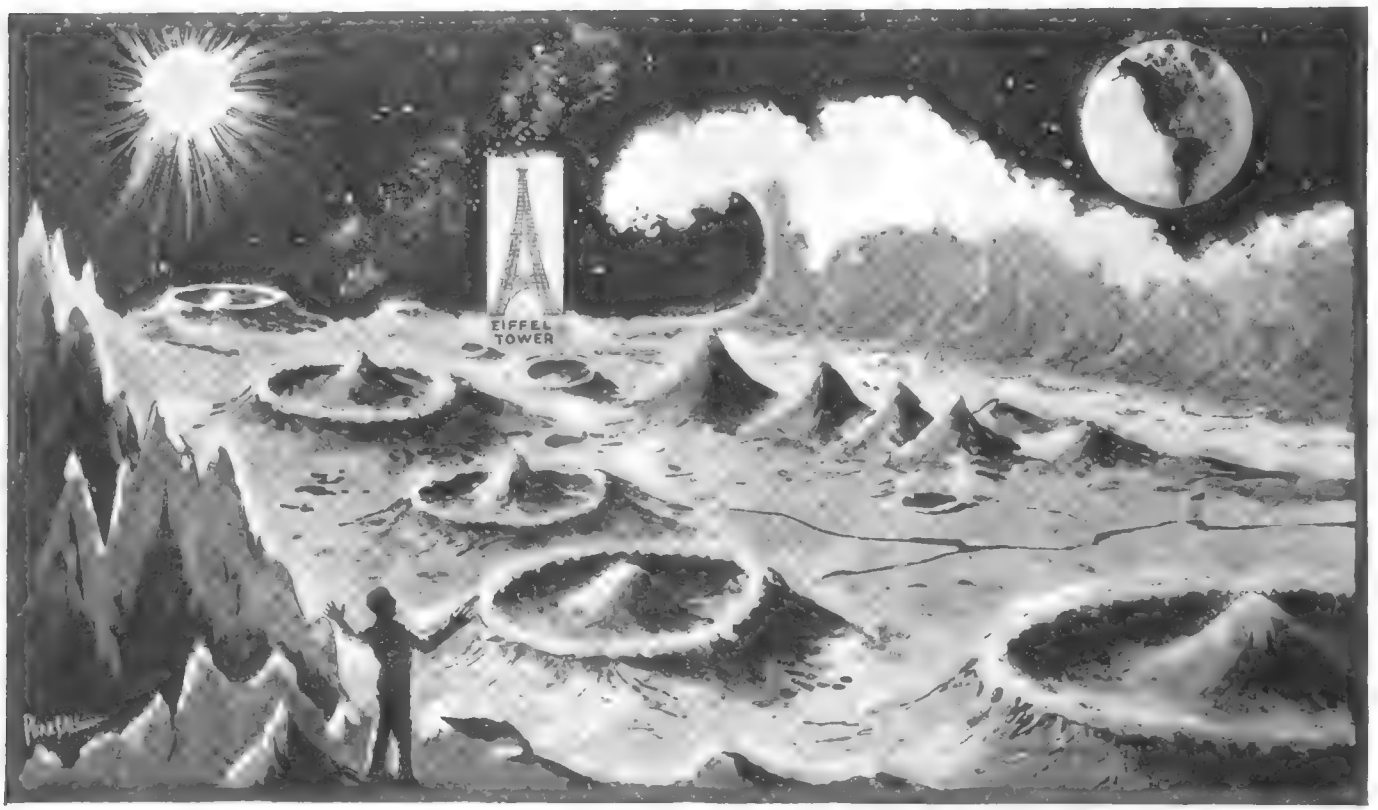
By ISABEL M. LEWIS, M.A.
of U. S. Naval Observatory

The Tides—How They are Caused

THE tide-raising force that one body exerts upon another—as the sun or moon upon the earth—is directly proportional to the mass of the disturbing body, and inversely proportional to the cube of the distance. It, therefore, decreases very rapidly as the distance between the two bodies increases. It is for this reason that the tides raised upon the earth by the sun are inferior to the tides raised upon the earth by the moon. The sun is about twenty-five million, five hundred thousand times more massive than the moon. If mass alone were to be considered the solar tides would be twenty-five million, five hundred thousand times greater than the lunar tides. However, the sun is three hundred and eighty-nine times more distant than the moon and since the tide-raising force also varies *inversely* as the *cube* of the distance the effect due to mass must be reduced by the effect due to distance. Now the cube of three hundred and eighty-nine is fifty-eight million, eight hundred and sixty thousand, and dividing the mass of the sun relative to the mass of the moon by the distance of the sun relative to the distance of the moon, we get about forty-three hundredths as the tide-raising force of the sun upon the earth, as compared to that of the moon. Ocean tides produced by the sun have then only about forty-three hundredths of the range of the tides produced by the moon.

According to what is called the equilibrium theory of the tides the effect of the tide-raising force upon the earth is to draw the fluid portions of the earth's surface—which are of course more readily acted upon—into the form depicted in Fig. 1. As particles nearest the disturbing body are the most attracted, two tidal waves tend to form directly beneath the disturbing body at A and at C, since A is attracted more than O, and O more than C, by equal amounts, while the water is drawn away from its normal position at B and D. As the earth rotates with respect to the sun once in twenty-four hours and with respect to the moon once in twenty-four hours and fifty-one minutes, on the average, there should be a compound tidal wave due to these two causes crossing the meridian at intervals of twelve hours approximately; while midway between these intervals of high-water there should be intervals of low-water. In other words every six hours, high and low tide should occur alternately at every port, due to the *combined attraction* of the sun and moon.

At new moon and at full moon the sun and moon are on the meridian at the same time, and the crests of the tidal waves raised by the two bodies coincide. At first quarter and last quarter the crest of the lunar tidal wave coincides with the trough of the solar tidal wave, as the sun and moon are then ninety degrees apart in the heavens. Representing by unity the lunar tidal force, then the solar tidal force, as we found above, is 0.43. At new and full moon, when the two forces act in conjunction, the total tidal force is 1+0.43 and at first and last quarter when the two forces are opposed to each other the total tida force is 1 — 0.43, or 0.57. The range of the tides at new moon and full moon, called *spring* tides, should compare with the range of the tides at first and last quarter called *neap* tides, as 1.43 to 0.57, or about as three to one, as in fact they do.



Millions of Years Ago, When Our Satellite Had Oceans, the Same as Our Earth, Due to the Tremendous Gravitational Attraction Between the Earth and the Moon, Gigantic Tidal Waves Were Raised Upon the Moon, Which in Some Localities Must Have Exceeded 1000 Feet in Height. Our Illustration Shows This Graphically.

According to the theory of the tides, the highest tide should occur at new and full moon *exactly at noon and midnight*, as the sun and moon then cross the meridian simultaneously. As a matter of fact this could only occur if the earth were a non-rotating body, covered by an ocean of uniform depth so that each tidal wave would have an opportunity to act with full force and without the disturbing effect of friction. In reality the observed tides do not conform to the requirements of the equilibrium theory or any other theory of the tides, so great is the complexity introduced by obstructing land barriers which deflect the tidal waves, and by varying depth of sea and diversity of coastal outline. It is in lakes alone that the extremely slight tidal oscillation shows any conformity to the requirements of the equilibrium theory of the tides. A lake is so small compared to the size of the earth, that its waters respond almost instantly to changes in the tidal forces and the complications that make it so difficult

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to formulate a satisfactory theory of ocean tides, do not exist in a lake a hundred miles or so in extent.

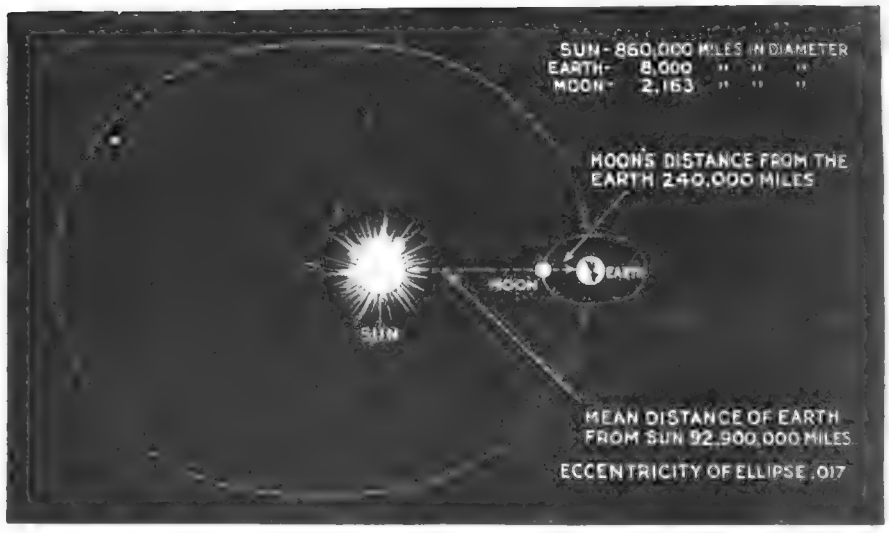
The tide in a lake of this size is very difficult to detect, however, because it is so small. The lunar tide at the ends of a lake 120 miles long has a range of two-thirds of an inch, and the solar tide is only about four-tenths as great, so that the combined tide on a lake of this size has a range of scarcely one inch.

Since a pendulum sways to and fro by a minute amount too small to detect under the action of tidal forces, and since the surface of water is always perpendicular to the direction in which the pendulum points, the tide in lakes manifests itself by a slight swaying or rocking to and fro of the waters of the lake. The inch or so depth of tide produced at the ends of the lake in this way is usually completely masked by the effects of the blowing of the wind from one end of the lake to the other, or by earth tremors or other causes.

An almost completely land-locked sea, such as the Mediterranean Sea resembles rather a great lake than an arm of the sea. The range of tides in this sea are comparatively small, ranging from a few inches to three feet or so in the Adriatic, which on account of its form is particularly favorable for augmenting the height of the tides.

In mid-ocean the range of the tides is very small compared to the range in certain bays and harbors along the coast and they consist of a slight upward and downward oscillation of the water. At small islands in the mid-Pacific the range of the tides is usually between two and three feet only. As the tidal wave runs into shallow water its motion is retarded and its shape is changed. The front slope of the wave becomes steeper and higher and the rear slope more gradual. When the advancing wave runs into the mouth of a river the current of the river tends to increase, by its opposition, the steepness of the advancing wave-fronts and when in the river there are extensive flats of sand or mud which are uncovered at low-tide the tendency of the advancing waves is to pile up rapidly into a formidable wall of water, known as a "bore," which is extremely dangerous.

Although the rise and fall of the tide is slight in mid-ocean, it often attains a great range at certain points along the coast, owing to the contour of the coast or the shallowness of the water or both.


SUN - 860,000 MILES IN DIAMETER
EARTH - 8,000 " " "
MOON - 2,163 " " "
MOON'S DISTANCE FROM THE EARTH 240,000 MILES
MOON
EARTH
SUN
MEAN DISTANCE OF EARTH FROM SUN 92,900,000 MILES
ECCENTRICITY OF ELLIPSE .017

At the Period of the Year When Sun, Moon and Earth Are in This Position, Nearer to Each Other Than at Any Other Time and in Line as Shown, the Joint Tidal Action of the Three Bodies is Greatest. It Will Be Seen That the Sun as Well as the Moon Are Pulling the Tide Waves Upon the Earth, Both Operating Together, With the Consequence That the Tides at This Time of the Year Are at Their Highest. These Are the So-Called Spring Tides.

A range of tide of thirty feet is by no means unusual at many ports. The highest tides recorded, those in the Bay of Fundy, usually have a range of fifty or sixty feet and in exceptional instances they have a range of between seventy and one hundred feet. The great height of the tides there is due to the fact that the bay converges after the manner of a funnel, forcing the tides into a corner. In land-locked bays and seas the range of the tide is small and in funnel-shaped bays and harbors it is great. The tides of the North Atlantic Ocean are on the whole comparatively simple in their nature for this ocean is more like a great bay than an ocean. The tide that we observe to-day in the North Atlantic was propagated off the Cape of Good Hope from thirty-six to forty-eight hours earlier, being generated by the great tidal wave which swept westward at that time from the Indian Ocean toward the Pacific. It is in the Pacific Ocean that the tidal wave has the greatest freedom, and it is here also that it is most complex and conforms least to the tidal theory. According to the equilibrium theory of the tides, there should be a difference in the range of successive tides, that is in the height of high tides separated by a twelve-hour interval. Why this should be so can be seen from a consideration of the position of the two tidal crests, one formed directly under the moon and the other at the antipodal point. If the moon were overhead twenty degrees north of the equator one tidal crest would be formed, according to theory, under the moon in this latitude, and the other tidal crest at the other end of the earth's diameter through this point, that is, at the antipodal point twenty degrees south of the equator. See Fig. 1.

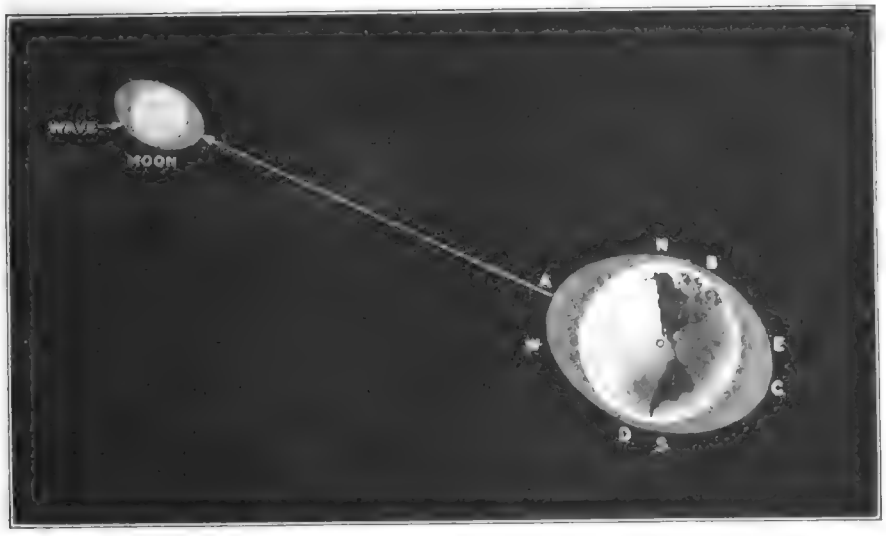
Now an observer on the earth is carried around by the earth's rotation parallel to the equator, so he should meet the first tidal wave near its crest if he is in high northern latitude; and the second tidal wave at a much greater distance from its crest, since it lies on the opposite side of the equator. The difference between the range in successive high tides at any one point, due to this cause, is called *the diurnal inequality of the tides.* Of course this diurnal inequality should disappear when the moon is over the equator and also if the observer is situated on the equator. It should be very small, then, near the equator and very appreciable in high latitudes. Now, as a matter of fact, there is a very considerable difference in the range of successive high tides in the high latitudes in the Pacific Ocean, *but it is in the reverse direction as predicted by the theory* while in the high latitudes of the North Atlantic, this diurnal inequality of the tide is practically non-existent. Such are the difficulties in the way of attempting to explain by any theory of the tides the nature of the complex tidal wave produced by a variety of conflicting causes.

Of course the height of the tides is affected by the varying distances of the sun and moon from the earth. When the moon is in *perigee* or nearest the earth, it is about thirty thousand miles nearer than when it is in *apogee* or farthest from the earth. As a result there is a range in the lunar tides of fully twenty per cent., due to this cause alone.

The range of the solar tides varies likewise with the time of year being highest when the earth is nearest the sun or in *perihelion* in the winter, and lowest when it is farthest from the sun or in *aphelion* in the summer.

The highest tides occur at the time of new or full moon, about the first of Jan-

(*Continued on page* 547)



This Diagram Shows How the Attraction of the Moon Tends to Raise Two Tidal Crests on Opposite Sides of the Earth. The Attraction of the Sun Tends to Raise Similar Tidal Crests, the Two Combining to Form One Compound Tidal Wave.

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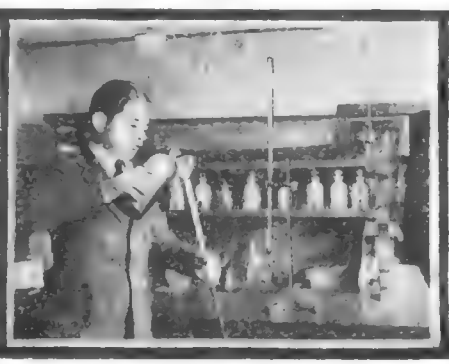
Practical Chemical Experiments

By PROF. FLOYD L. DARROW

EXPERIMENTS WITH STANDARD SOLUTIONS

OUR analytical work has been practically all *qualitative*, dealing with the kinds of substances present and not with the quantities, or relative proportions. In this article, however, we shall take up some *quantitative* determinations. Much of this work is done with what are called *standard solutions*. A liter of the solution is made to contain a definite known weight of the acid or base. The value, then, of any number of cubic centimeters of the solution is known.

Illustrating the Correct Method of Reading a Burette, by Placing Around It a Narrow Strip of Colored Paper, and Keeping the Eye on a Level With the Front and Back Edges of the Paper.



Introducing "Cleaning Solution" into a Burette for Removing All Traces of Grease and Dirt. The Apparatus Should be Kept Clean at All Times.

Demonstrating the Effects of the Various Indicators on the Common Acids and Bases. Introducing the Indicator With the Dropper Shown in Fig. 1.

Indicators: For carrying out this work certain solutions called *indicators* are required. These are organic substances which usually give one color with a base and another characteristic color with an acid. The most common ones and those that we shall use are *phenolphthalein*, *methyl orange*, and *litmus*.

Phenolphthalein: To prepare this indicator dissolve 1 gram of the dry powder in 100 cc. of alcohol. (Denatured alcohol will serve.)

To learn the effect of this indicator on solutions of acids and bases arrange six small beakers in a row. In three of them place dilute solutions of sodium, potassium, and ammonium hydroxides, and in the other three dilute solutions of hydrochloric, sulfuric and nitric acids. Now introduce a few drops of the indicator into each beaker. You will observe that the bases give a delicate pink color while the acids remain colorless.

Now to the three acid solutions which show no color add sodium hydroxid solution, a little at a time, with constant stirring until a pink color appears. Evidently the base has been added until the acid has been neutralized and excess of base is present.

To the three beakers which were originally pink, add hydrochloric acid with constant stirring, until the pink color disappears. Here the base has been neutralized and acid has been added in excess.

Methyl Orange: Prepare this indicator by dissolving a quarter of a gram of the substance in a few cubic centimeters of alcohol and dilute the solution to 250 cc. Now repeat the same experiments with this indicator that you have just done with phenolphthalein. Note that a base gives a definite yellow color, while an acid gives a red.

Litmus: In the bottom of a beaker place a few cubes of litmus. Cover them with alcohol and heat cautiously over a low flame for a few minutes. Should the alcohol vapor take fire smother the flame by thrusting down upon the top of the beaker a piece of asbestos paper. Pour off the alcohol, fill the beaker half full of water and bring it to a boil. When cold filter the solution and preserve in a glass stoppered bottle for use.

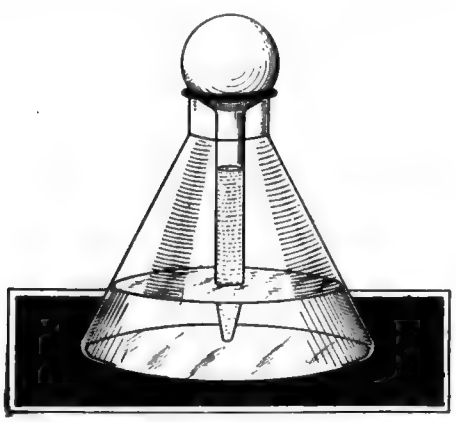


Fig. 1 Above Shows How the Glass Dropper for Adding the Indicator Is Constructed. It is not as Difficult to Make as Might at First Appear.

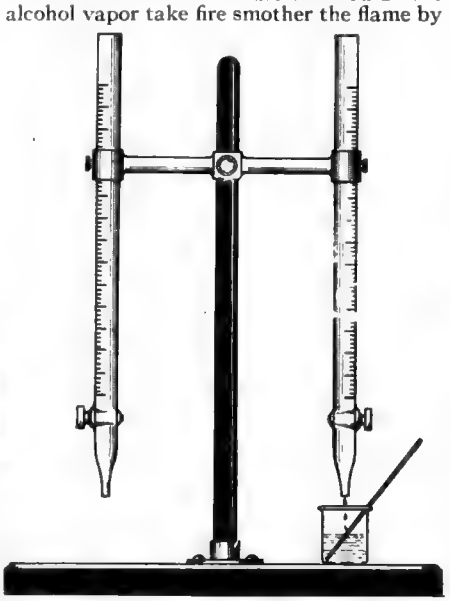


Fig-2

Fig. 2 Above Shows Two Graduated Glass Burettes Mounted so as to be Suitable for Carrying Out Titration Experiments.

Repeat the same experiments with litmus that you have already done with the other indicators. Acids will turn it red; bases will restore the blue color.

Making a Dropper: To make a dropper such as that shown in Fig. 1, for the indicator, proceed as follows: Select a short piece of rather thick-walled glass tubing and heat one end in the Bunsen flame until it softens and closes. Then place the other end in the mouth and quickly blow it out into a fair sized bulb. If it does not come well the first time, remelt it and blow again. With a little practise you will become an expert at it. When cold draw the open end out by softening in the flame until only a small opening remains and cut it off. Make three of these droppers.

In a small flask place a few cubic centimeters of one of the indicators and introduce the dropper as shown in the diagram. Brush the flame of the Bunsen burner over the bulb two or three times to expel a little of the air. Then as the bulb cools some of the liquid will be drawn up into the tube. To use the dropper take the bulb in the warm palm of the hand and the expansion of the air will force out the liquid in drops. Upon replacing it in the flask the cooling and contraction of the air in the bulb will draw more of the liquid back into the tube.

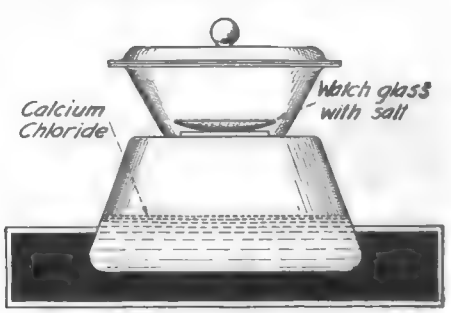


Fig-3

Fig. 3 Shows a Glass Desiccator Which Will be Found Useful for Many Different Experiments.

Determination of the Endpoint: In order to learn the process of *titration*, and what is

(*Continued on page* 549).

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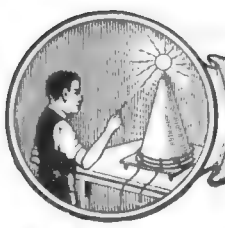
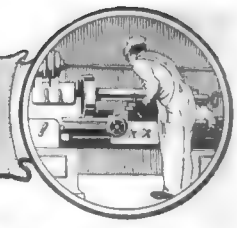


THE CONSTRUCTOR



How to Build a 1/16 H. P., A. C. Motor

By H. JOHNSTONE

MANY experimenters undoubtedly have a use for a small alternating current motor suitable for operation on a potential of 110 volts and a frequency of 60 cycles, but do not care to buy such a motor unless it is absolutely necessary. The accompanying description and ilustrations show how to build a 1/16th H. P. induction motor of the single-phase self-starting type. The design here given is the simplest that has ever been developed, as there are no starting coils to be wound, simply four stator coils. The squirrel-cage rotor or revolving member comprises a laminated sheet iron drum core, having 24 slots as shown, which slots are filled with 24 inductor bars, composed of heavy copper wire. The cross-sectional view at Fig. 1-B, shows how these copper bars are joined at both ends of the rotor by flat copper rings, and the ends of the inductor bars riveted over and sweated with solder.

The dimensions of the laminated sheet iron rotor and stator are given in Fig. 1. For ordinary work, black Russian sheet iron as purchased at any tinsmith's, will serve very well for the purpose, and the requisite number of sheets can be cut out with a pair of tinner's snips. The sharp corners, such as those around the stator poles, can be cut out with a cold chisel and hammer. The 24 inductor holes in the rotor may be drilled thru the rotor iron laminations by clamping them tightly and performing the operation in a drill press. By means of two blades placed in a hack saw frame side by side, the thin slots over the top of each round inductor channel in the rotor are cut thru. The rotor supporting spider should be made of brass or bronze; it could be made of iron, but this is liable to heat up more. The details of the bearings, shaft, and other parts are left mostly to the individual builder, for these will often be governed by circumstances. Thus 1/16" diameter shafting may be available instead of 1/4" shafting, etc.

Let us now consider the stator and its four coils as well as the copper starting or shading plates, at C. The four stator coils are composed of 230 turns of No. 23 B & S gage enameled magnet wire, but if this is not available, single silk covered magnet wire may be used. This will require somewhat over two ounces of wire per coil, and 1/4 of a pound of wire should suffice for the whole job. A simple wooden

(Continued on page 561)

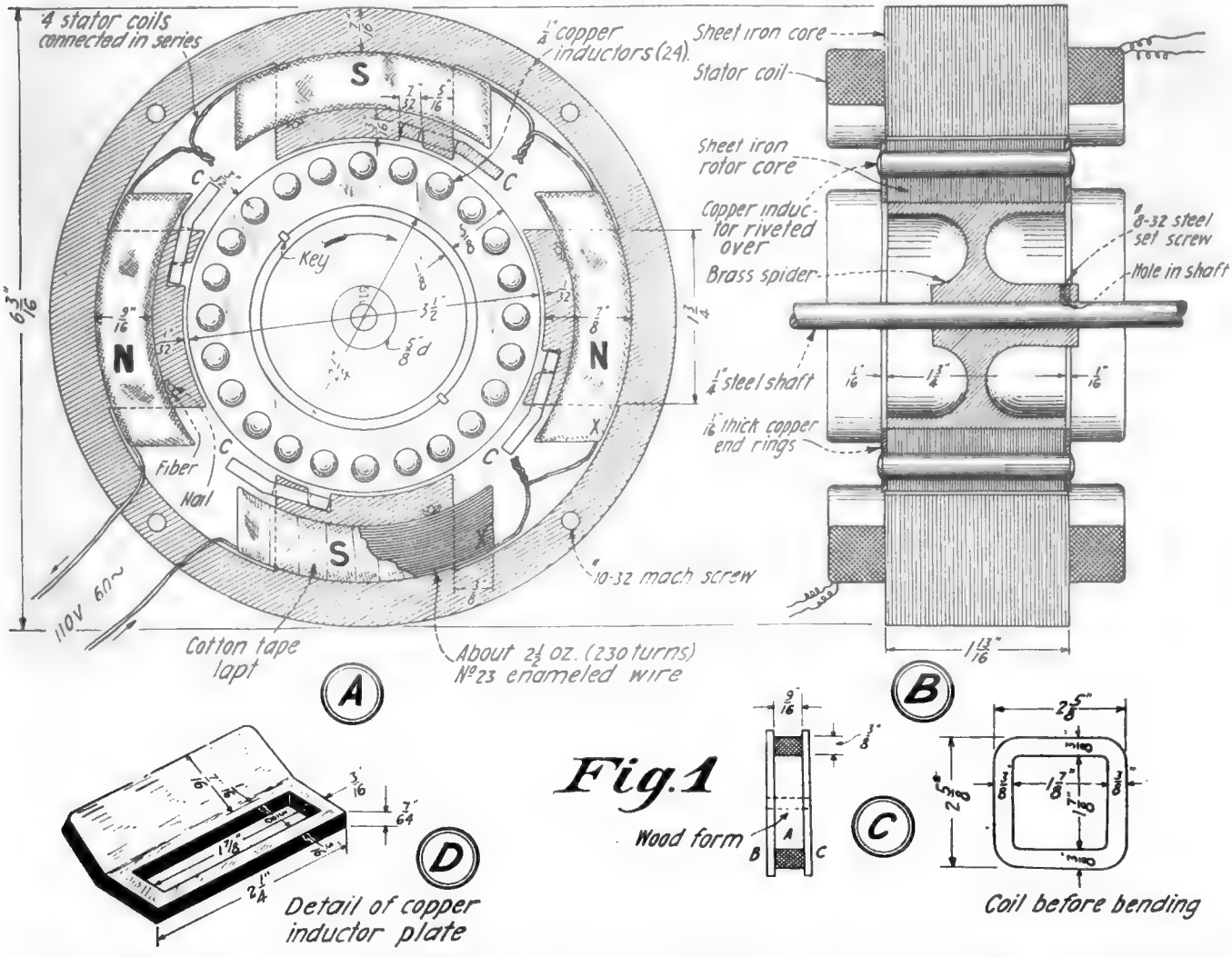


Fig. 1

Details for Building a 1-16 Horse-power A. C. 110-Volt Motor are Here Given. The Constructor Will Find This Design Very Simple, There Being but Four Stator Coils of Square Shape, While the Rotor is "Wound" with 24 Round Bare Copper Wires Passing Thru Slots in the Iron Rotor Core as Shown. The Motor Is Self-Starting Under Load and Develops a Reasonably High Torque at Starting. It Makes an Ideal Fan Motor for Use with a 10- or 12-Inch Diameter Blade. Many Other Uses Will Suggest Themselves to the Builder. The Speed is Very Constant with a Given Load.

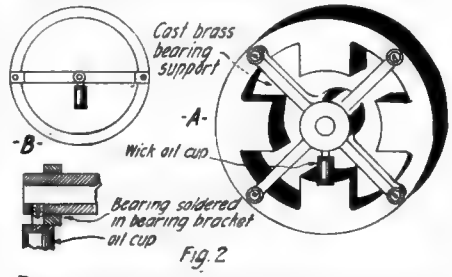


Fig. 2

Detail Suggesting How Bearings May Be Constructed, but This is a Matter of Choice. It Is Best to Have a Machinist Accurately Aline the Two Bearings and Drill the Holes in the Brackets.

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Preparing Objects for the Microscope

By EARLE R. CALEY

AN intelligent application of the knowledge of the various mounting media and their relation to the object to be mounted is essential.

In order to make slides successfully a few simple pieces of apparatus are necessary which can be easily made or arranged by the amateur.

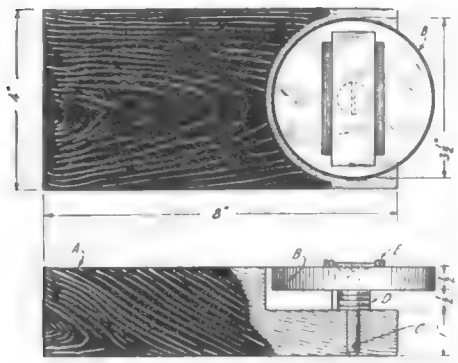


Fig. 1 Shows a Turntable for Making Microscope Slides. The Base "A" Is Made from a Piece of 2"x4" Wood. The Revolving Table "B" Should be Made of Brass, but can be Made of Wood. The Steel Pin "C" on Which the Table Revolves Is Separated from the Base by the Washers "D." The Slide Is Held in Place by the Guides "E", as Shown.

Fig. 2 (Right) Shows an Ordinary Glass Desiccator.

Apparatus Needed for Making Microscope Slides

The slides are usually crystal glass slips exactly 1"x3" and are finished with ground edges. They must be thoroly cleaned and polished before use. An excellent preparation for this purpose is given in the formula below:

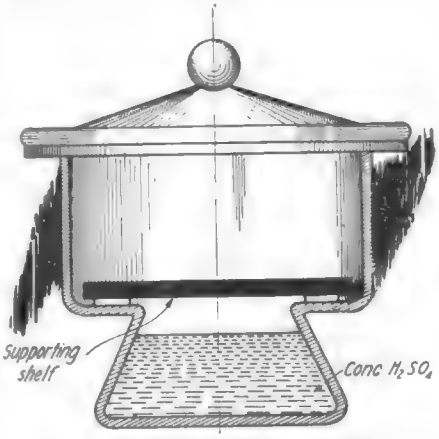
Ammonium Hydroxid.....	10 drops
Denatured Alcohol.....	2 oz.
Water.....	½ oz.
Rouge—Sufficient to make a thin cream	

Cover glasses are small round or square pieces of extremely thin glass, and come in varying sizes and thicknesses. For objects requiring a high power in their examination, only the very thinnest cover glasses can be used.

A good many objects mounted are comparatively thick and the delicate cover glasses need some support at the edges to prevent breakage of the objects. This is usually done by building up a thin wall of varnish in a circle around the object and then mounting the cover on this. Very deep cells have walls of hard rubber or tin. In order to build up these cells in accurate circles and also to place on the finishing varnish a revolving turntable is needed. This is shown in the appended drawing and may easily be constructed by the amateur.

An ordinary hot air drying chamber is also a useful but not altogether essential piece of apparatus since in cases of necessity the kitchen stove oven can be requisitioned by the experimenter for this purpose. Some form of desiccator is necessary for the dry mounting of objects. The usual form is shown in the illustration. Concentrated sulfuric acid is kept in the lower division, while the slides to be dried are kept above. An old tobacco humidor can be used for this purpose as shown in the illustration. Besides these few pieces of apparatus several fine camel's hair brushes, needles, a pair of scissors, and a scalpel or sharp penknife will be needed.

Another useful piece of apparatus is a jeweler's eye-glass for inspection of unfinished slides; it can also be used to aid in mounting objects. A considerable number of liquid preparations and varnishes are required for making slides and are listed together with a number of useful formulas for making them.



Making Cells on Microscope Slides

Place a clean slide upon the turntable as shown in the drawing, and as it is turned by hand, make three concentric rings upon it with a writing diamond. This causes a more perfect adhesion of the varnish. Now take up a camel's hair brush filled with heavy cell varnish, and, giving the turntable a spin, deliver it upon the roughened rings in such a manner that the varnish stands up like a wall and does not spread itself over the slide. When this layer is thoroly dry another layer is put on and so on until a cell wall of the desired depth is built. The slide should then be baked at a low temperature for a long period in a hot air oven to thoroly dry the varnish. Shellac varnish is satisfactory for dry mounting altho other varnishes such as black asphaltum may be just as well used. Deep cells are made of hard rubber, tin, brass, etc., and these are mounted on the slide with glue or cement. Under no circumstance should paper or cardboard cells be used, since moisture is absorbed by these and the preparation may be ruined. It is best to make a number of cells of various sizes at one sitting as this saves considerable time.

Method I.—Mounting the Objects in a Dry State. (Dry Mounting)

The first operation in mounting is cleaning the specimens. Remember that an object, appearing clean before the naked eye, can appear quite dirty when magnified several hundred times. All the instruments necessary in this work are several camel hair brushes (some cut off short), forceps, knives, and scissors. Most objects are best cleaned under water in a trough or open cell on the stage of a dissecting microscope, or with a jeweler's eyepiece. Next the objects require to be dried. They are placed on slides and put in the drying chamber of a desiccator. In mounting objects dry, *all* the moisture must be removed since animal and vegetable substances, mounted when even slightly damp, become covered with a fungus growth after a short time. A week is not too long a time to leave the objects in the desiccator. After thoro drying it is then ready for mounting on the slide.

Select a slide and cell which is just deep enough to accommodate the object to be mounted. The object is then placed in the cell and a suitable clean cover glass selected and coated on the edge with shellac with a fine brush. When this shellac has nearly set the cover is placed on the cell and prest until fastened all around. After standing an hour or so, the slide is again placed upon the turntable and a coating of shellac applied so as to seal the cell wall and the cover glass. The slide should now be put away for several days and is then examined under a suitable power. If the object is well cleaned and shows clearly and accurately what it is intended to show, then the slide should be finished. To finish, a circle of white enamel is painted around the cell about ¼ inch wide, and when this has dried various colored rings are turned upon it with very fine brushes.

Mounting Diatoms. The following process is taken from the *American Journal of Microscopy* for April 1880. Boil the diatomaceous matter with strong nitric acid for twenty to thirty minutes and while yet boiling add about an equal quantity of muriatic acid, continuing the boiling for twenty to thirty minutes longer. After washing out the acids boil in pure sulfuric acid, until the mass becomes inky black, then throw in fragments of bichromate of potash and continue boiling until it becomes clear. If on examination with the microscope there is seen much flocculent matter, besides sand and diatoms, it can be removed by boiling a few seconds with caustic potash and instantly plunging them into pure distilled water to destroy the action of the potash. The diatoms are now chemically free from all organic matter and should be placed on a watch glass, distilled water added, the watch glass rotated and

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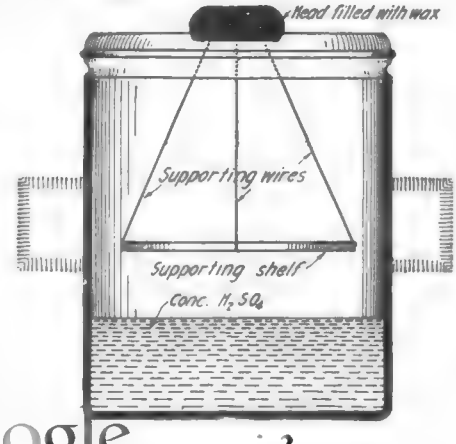

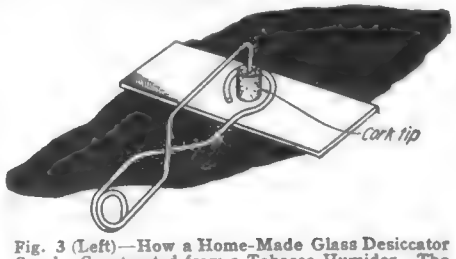

Fig. 3 (Left)—How a Home-Made Glass Desiccator Can be Constructed from a Tobacco Humidor. The Glass Shelf, for Holding the Microscope Slides Above the Desiccating Agent During Preparation, Is Supported by Embedding the Ends of These Wires in the Hollow Knob of the Cover. The Glass Jar Contains a Solution of Concentrated Sulfuric Acid. Be Extremely Careful not to Spatter Acid on the Skin, as it Will Burn Severely.

Fig. 4 Illustrates a Spring Clip Used for Holding Microscope Slides While Heating Them.

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A Simple Vacuum Pump

By FRANK L. ABBOTT

DEPT. OF PHYSICS, COLORADO STATE TEACHERS' COLLEGE

A VERY good air pump can be made from an automobile pump as it will in no way damage the latter for its ordinary use. In order to change the compression pump into an air pump remove the piston rod from

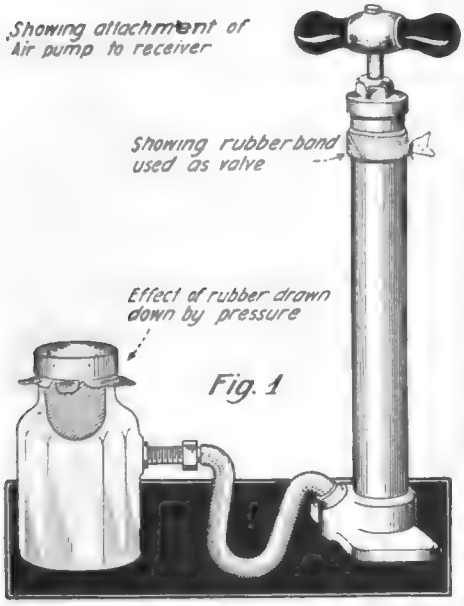
Showing attachment of Air pump to receiver
Showing rubber band used as valve
Effect of rubber drawn down by pressure
Fig. 1

Fig. 1—This Shows a Suction Pump, Constructed from a Compression Type Tire Pump, Connected to a Glass Vessel Over Which a Piece of Thin Sheet Rubber Had Been Tightly Stretched and Secured with a String or Otherwise. When the Pump Is Operated, the Exhaustion of the Air from the Glass Vessel Will Cause the Rubber to Sink Inwardly.

the pump barrel, unscrew the nut from the rod and remove the valve. Keep the two iron washers and the leather in their same positions. Fit tightly a thick piece of new harness leather into the cap of the pump; cut a hole in this leather in the cap and *force* the piston rod thru the hole. The rod must fit air tight thru the leather. Replace the spring and valve on the piston rod, but the valve must be reversed from what it was when taken off. See sectional view of pump.

About one inch from the top of the pump barrel drill a one-sixteenth inch hole, smooth off the burr on the inside of barrel caused by the drilling of the hole. Replace the piston and screw on the cap. A ¼ inch rubber band placed over the exhaust hole

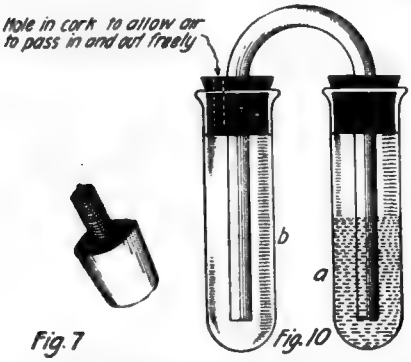

Fig. 7—Valve Stem from Inner Tube Fitted into Cork for Experiments with Vacuum Pump. Fig. 10—Shows Two Test Tubes Arranged with a Piece of U-Shaped Glass Tube, and with Water Placed in One of the Tubes; Under Exhaustion the Water in the First Tube Will Pass Over Into the Second Tube or Chamber B. This Apparatus is Placed in a Receiver (See Fig. 9) Whence the Air Is Then Exhausted.

acts as a valve (see sectional view). This rubber band should be drawn tightly enough to keep it from slipping down the barrel. If the leather in the cap does not stay in place put a cork in the top of the pump to press against the leather.

Receiver for Air Pump.

To make a receiver for this air pump is also a very simple matter. Many experiments can be made with this pump and receiver. In fact all the experiments given in the ordinary high school text book can be performed with this inexpensive apparatus. Procure a Heinz relish or pickle bottle or any other wide mouth bottle of a similar shape. Also secure one of the small size old valve stems from the inner tube of an automobile tire; remove the valve core. Drill a hole in the bottle of sufficient size for the valve stem. Using pieces of inner tube for washers, fasten the stem into the bottles (see drawing). To drill the bottle use a saw file, grinding the sides equally to a very sharp point, as shown in drawing, Fig. 4. Care must be taken not to *heat* the file while grinding. Put the file in a brace and use it as an ordinary drill is used, keeping the point well wet with turpentine. Three minutes is ample time for drilling the hole thru the bottle. Care must be

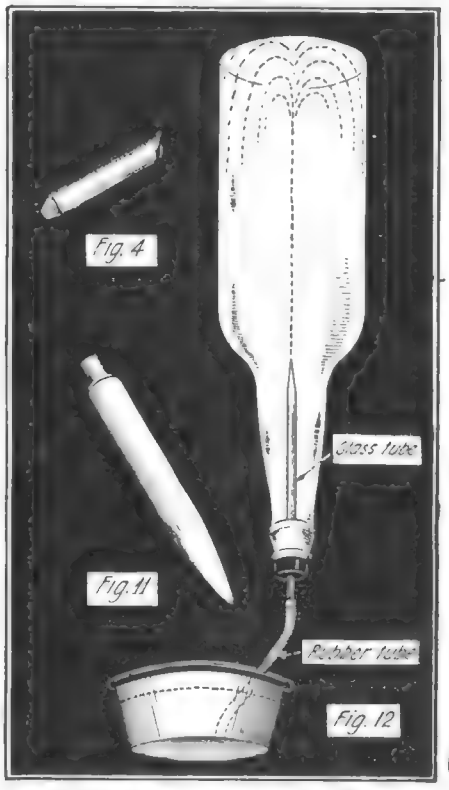

Fig. 4—Piece of Saw-File Ground to a Sharp Point for Drilling Hole in Glass Bottle. Fig. 11—Valve Stem from Tire Inner Tube, Ground to a Taper at One End and Used for Connecting Air Pump to Rubber Tube. Fig. 12—Shows How Evacuated Bottle, When the Pump Tube is Disconnected and Placed Under Water, Will Cause the Water to be Forced up into the Bottle, Due to the Air Pressure of 14.7 Lbs. per Square Inch.

exercised when the hole is almost thru the bottle or it will be broken. If the hole is not large enough with the drill use a rat tail file and turpentine to enlarge it.

Experiments With Air Pump.

Experiment 1. Connect the pump and receiver as shown in drawing, Fig. 1, place the palm of the hand over the mouth of the receiver and exhaust the air. The hand will be held fast to the receiver.

Experiment 2. Tie a piece of sheet rubber over the mouth of the receiver and exhaust the air. The rubber will be pushed

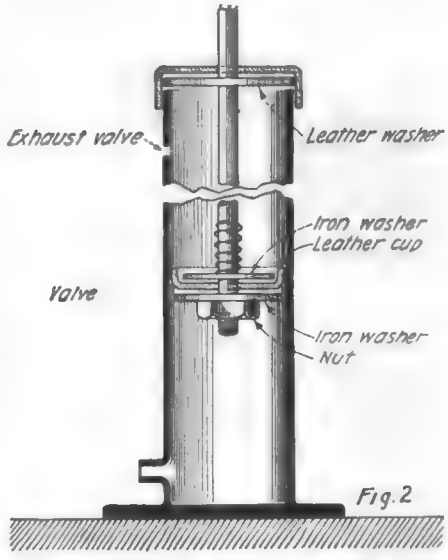

Fig. 2—Sectional View of Vacuum Pump Constructed from a Compression Tire Pump. The Changes Necessary are Slight and a Very Good Laboratory Air Pump Results.

down into the receiver as shown; thus showing the great pressure of the air.

Experiment 3. Place the mouth of the receiver in a dish of water and draw the piston back slowly. The water will rise in the receiver. This experiment illustrates the principle of the common lift pump.

Experiment 4. To make a seal-plate or air-tight cover for the receiver. Secure a piece of glass a little larger than the mouth of the receiver, lay the glass on the table and put some wet emery powder on it. Put the mouth of the receiver on the glass and with a rotary movement grind the glass and receiver. A few minutes' grinding will make an air tight fit, especially if a little grease or vaseline is used between the seal plate and the receiver. (See Fig. 8.)

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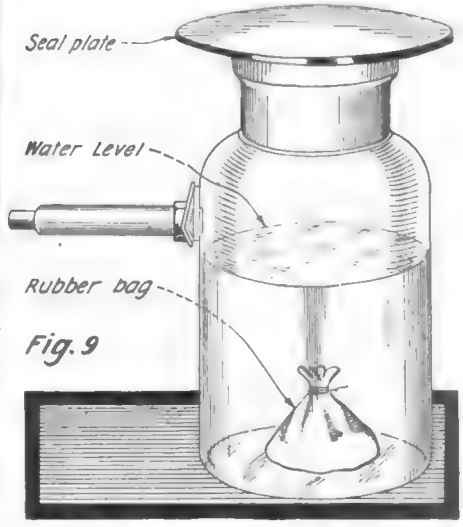

Figs. 8 and 9—Illustrating the Glass Receiver and the "Seal-Plate," Which Latter Should be Ground to Make a Perfect Fit with the Receiver; a Little Vaseline or Tallow Will Help to Make the Seal Thoroly Airtight.

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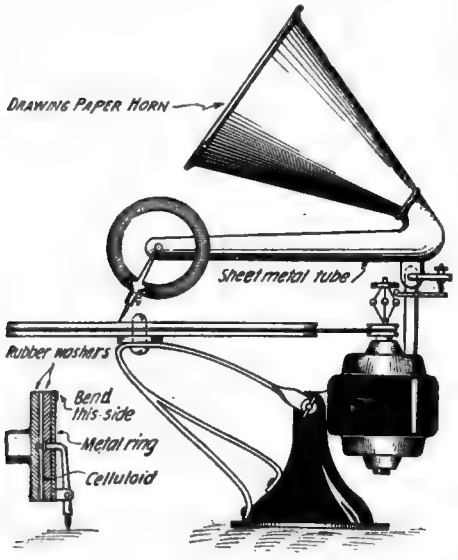
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

AN ELECTRIC PHONOGRAPH

It is not often that the average experimenter has a fan motor, which can be used for no other purpose than to make a phonograph of, but I just happened to be one of the fortunate ones and desired a phono-



A Clever Home-Made Electric Phonograph, Driven by a Fan Motor to Which an Adjustable Ball Governor Is Fitted, so That the Speed of the Record Can be Controlled to the Proper Degree, 68 R. P. M.

graph immensely. Accordingly I removed the fan blades and turned the motor into a vertical position. I then fastened a sheet metal brace to the base of the fan, as shown in the illustration, and at the bend a pin was mounted so as to make the bearing of the turn table. This was a simply constructed wheel the top of which was covered with felt for better appearance's sake. A groove was filed into the edge of the wheel which communicated by means of a belt with a wheel subsequently mounted upon the motor. The most difficult attachment was the governor. Accordingly I purchased a governor from a phonograph house. However, there is no reason why the amateur builder could not construct one of these himself. Inasmuch as this construction of a governor has been described in past issues of your magazine, I will not go into detail of the construction here. Suffice it to say that the friction brake which makes contact with the sliding sleeve of the governor, is also mounted upon the same stand as illustrated, and a threaded screw is placed upon the lever so as to keep the speed normal. The rest of the phonograph was also constructed, the reproducer being made from a tin can almost 3" in diameter, two rubber washers, one metallic washer of the same size as the rubber washers and a piece of celluloid. A resistance was cut into the circuit in series with the motor, and the speed of the turn table carefully noted. By adjusting the resistance I was able to closely approximate the desired speed and the subsequent regulation was performed by adjusting the governor.

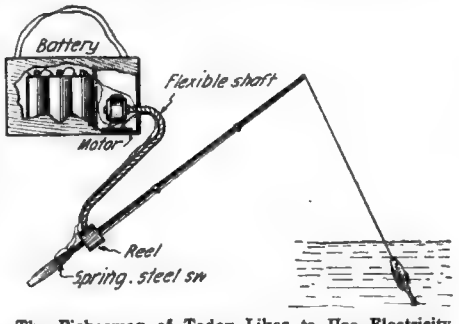
Contributed by CARL MAYER, Jr.

SECOND PRIZE, $3.00

FISHERMAN'S REEL DRIVEN BY ELECTRIC MOTOR

A battery and motor box made of thin, light lumber carries the small electric motor mounted on its base in one end of the box and a battery of 6 dry cells placed in the other end, the two being divided by a partition between. Instead of the driving pulley mounted on the end of the armature shaft of the motor, a small flexible shaft four feet long is attached, which passes out of one end of the box and attached at the opposite end to the end of the reel's shaft. A circuit is formed from the battery through the motor and one terminal grounded to the metal of the reel's frame and the other to the rear end of a steel spring, the front end of which presses down with the thumb to contact with the frame of the reel also. When the minnow is cast thru the air and reaches the desired spot to fall into the water the spring is prest, closing the circuit as a switch and the reverse motion set up by the motor winding the line stops the minnow, when it falls and starts it on its return. The braking device and the hand crank are removed from the reel and the spring switch serves as a brake, the motor automatically doing the rest. The flexible shaft allows the swing of the arm to cast the minnow and the motor hauls it in with swift speed. The box containing motor and battery are carried by a leather strap over shoulder.

Contributed by L. M. JORDAN.



The Fisherman of Today Likes to Use Electricity Whenever He Can—Here is an Electric Motor Reel Winder.

CLEVER TAPPING STUNT

When the tap is too small or the die too large, place a strip of tin over the tap to cover half of its surface, or in the die. This crowds the tap or die to one side, and therefore fills out the required size in the case of the tap and takes up the size in the case of the die.

If one strip of tin does not suffice, any number may be placed on top. The die will not cut thru the tin, but the tin will turn with the die.

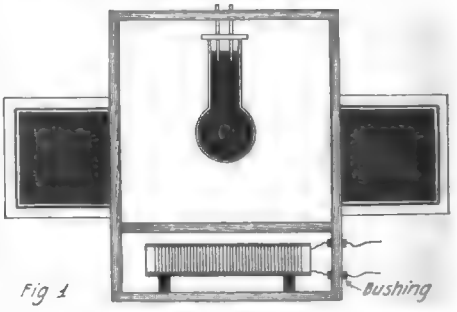
Contributed by J. F. KIDD.

When the Tap Is Too Small or the Die Too Large, a Piece of Tin Arranged as Shown Will Help to Cut the Proper Depth of Threads.

THIRD PRIZE, $2.00

AUTOMATIC ELECTRIC INCUBATOR

A very useful and interesting incubator may be made if the constructor will follow the drawings and the description herewith. This machine is easily made and is entirely automatic in operation. A heating element



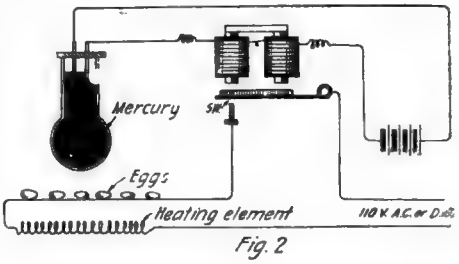


Fig. 2

With the Electro-Magnet and Tube of Mercury Here Shown, the Temperature of an Incubator can be Maintained at a Constant Value.

consisting of a coil of resistance wire wound around an asbestos tube is employed. This heating unit is placed in the incubator beneath the egg tray, as shown in Fig. 1. With the help of an electro-magnet, and a tube of mercury, the temperature is automatically maintained at 104 degrees Fah., which is the correct hatching temperature. As in all incubators, the eggs must be turned over and sprinkled occasionally.

The machine is kept at a constant temperature by a very simple switching device. A glass tube containing mercury is placed in the hatching chamber as indicated in Fig. 1. Thru the cover of this tube, two wires are inserted (platinum serves best), which are connected to a battery circuit and operate an electro-magnet. The manner of wiring this instrument is shown in Fig. 2.

If the temperature should exceed 104 degrees, the mercury rises and will make a contact between the two points. This energizes the electro-magnet which raises the armature, and opens the circuit to the heating element. As soon as the hatching chamber cools the mercury drops down in the tube, which breaks the circuit to the electro-magnet, and thus closes the circuit to the heating element.

I do not think it advisable to give any definite size for the heating element or the amount of mercury to be put in the tube, inasmuch as the experimenter usually changes things to suit himself; moreover, these two factors can be determined only by actual experiments.

Contributed by YALE LUNIN.

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RADIO DEPARTMENT

Testing Insulators and Controlling Power Systems By Radio

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Our Illustration Above Shows a New Application of "Radio" in Testing for Broken or Cracked Insulators Along Power Lines, While the Motor Truck Carrying the Apparatus Is in Motion. The "Leak" Current Passing Over the Cracked Insulator, Causes Etheric Waves to be Set Up, and These are Intercepted by the Loop Antenna of the Radio Set.

Another New Idea in Radio Control Method Has Been Devised by the Westinghouse Engineers and Provides for the Control of Switches, etc., at Sub-Stations on Large Electric Power Distribution Systems. Unlike Wire Systems the Radio Can Function in the Worst of Storms. Also the Cost of Long Wire Circuits for Such Control Is Eliminated.

TWO of the very latest innovations in the art of radio have been suggested and devised by the engineering experts of the Westinghouse Electric and Manufacturing Company. The first application of radio, which marks a new departure in transmission line maintenance, is the spotting of cracked or broken insulators, and the illustration shows how the radio detecting instruments, coupled with a loop aerial, are mounted on a motor truck. The defective insulators along the line are spotted by the abnormal sound heard in the telephone receivers worn by the tester.

The beautiful advantage of the radio method of testing for cracked insulators, which of course, always leak on high tension lines, is that such a test can be made more accurately than by other means and also more speedily, as the test car carrying the radio set and loop aerial can move along at a fair rate of speed. A very important feature of this method of locating cracked or broken insulators is the fact that ordinary inspection by a man driving along the road and trying to spot a defective insulator, which may be causing considerable leakage to ground, or a partial short-circuit, is very imperfect and in fact a crack would not be noticed in many cases, particularly if the crack is inside the insulator. By this radio test, however, the insulator or insulators, no matter how innocent they may look, are sure to be spotted as the test car moves by them, as the operator will hear a sputtering sound in the telephone receiver, caused by the Hertzian waves set up by the spark, however slight, where the current is leaking along the crack in the insulator.

The radio outfit required for this testing operation is not elaborate and costs but a nominal sum. The loop aerial can be made about 4 to 5 ft. square, and may be mounted on a vertical shaft provided with a wheel, so that it can be turned to any desired angle in order to intercept the ether wave disturbance set up by the broken insulator with the maximum efficiency. By turning the loop aerial at an angle of about 30 to 45 degrees and in the direction in which the motor truck is moving, insulators on several poles may be brought simultaneously within the range of the loop aerial. The loop may comprise about 10 or 12 turns of bare or insulated wire, spaced about 1 inch apart. The receiving instrument used should be of the vacuum tube type and should include preferably one detector tube, and at least two stages of amplification. No ground or counterpoise is used, both terminals of the loop antenna being connected to the receiver. Those desirous of trying out this arrangement, will find it the best practise undoubtedly, at the start, to rig up some defective insulators and connect these with a source of current, which will cause leakage over or thru

(*Continued on page* 579)

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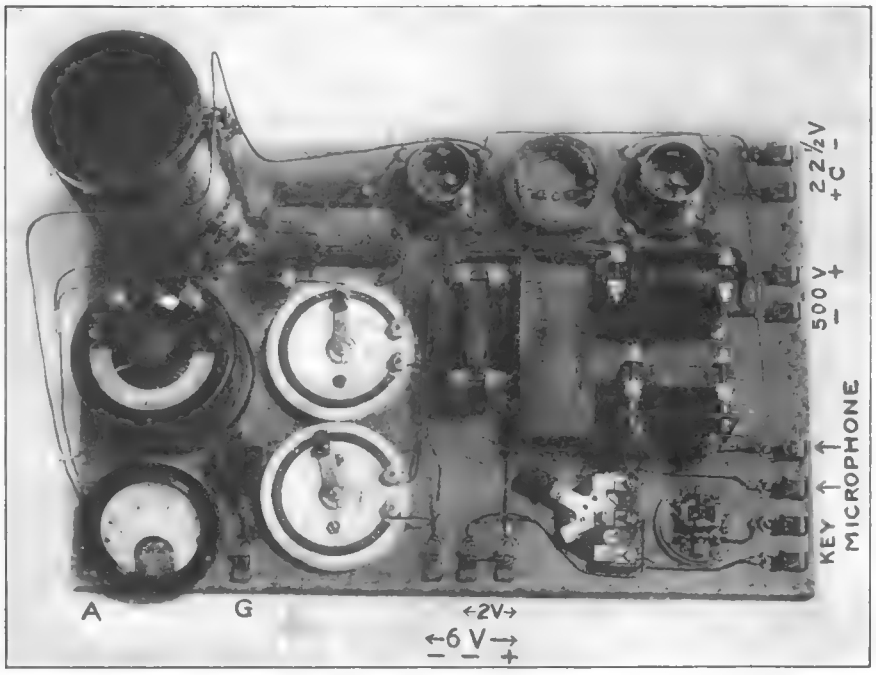
A Practical Radio Telephone Set

By ARTHUR H. LYNCH



Complete Radio Telephone Set, All Composed of Standard Apparatus, Is Shown Above, Complete Wiring Diagrams Are Shown on Opposite Page.

RADIO-TELEPHONY and continuous wave radio-telegraphy have come to assume such predominant places in the amateur and experimental world that it is a rather safe bet that bulb transmitters will continue in force for some little while. The number of stations being converted to bulb transmitters, as well as the number of new stations where bulb sets are installed, is ever on the increase. Little wonder! For, do we not find that C. W., of any sort, is far superior to any of the older forms of transmission, for a number of very important reasons, principal among them being a reduction of interference, due to a sharper wave. And reception thru atmospheric interference is made less troublesome, because it is possible to bring the received station in—where telegraphy is being used—at any desired tone value.

In October "Radio News"

Show Your Goods — *By Armstrong Perry*
A New Type of Variometer — *By Henry Oberg*
A Common Cause of Inductance From the Ship's Dynamo and Its Remedy — *By Stanley Edgar*
Amateur Reception on Honeycomb Coils — *By J. P. Jessup*
The Basket Woven Coil — *By G. W. Adams*
Hunting the Trouble — *By X. Perry Menter*
High Voltage — *By Richard E. Morris*

C. W. SHOULD BE USED, NOT FEARED.

Do not forget that it is no longer necessary for the amateur to make every piece of apparatus he would use, as was the case but a few short years ago. In order to have a station which will give entire satisfaction, it is no longer necessary for the radio enthusiast to experiment with various apparatus and various hook-ups for it; it is merely necessary to consult some authority on the subject, whether the authority be a book or person.

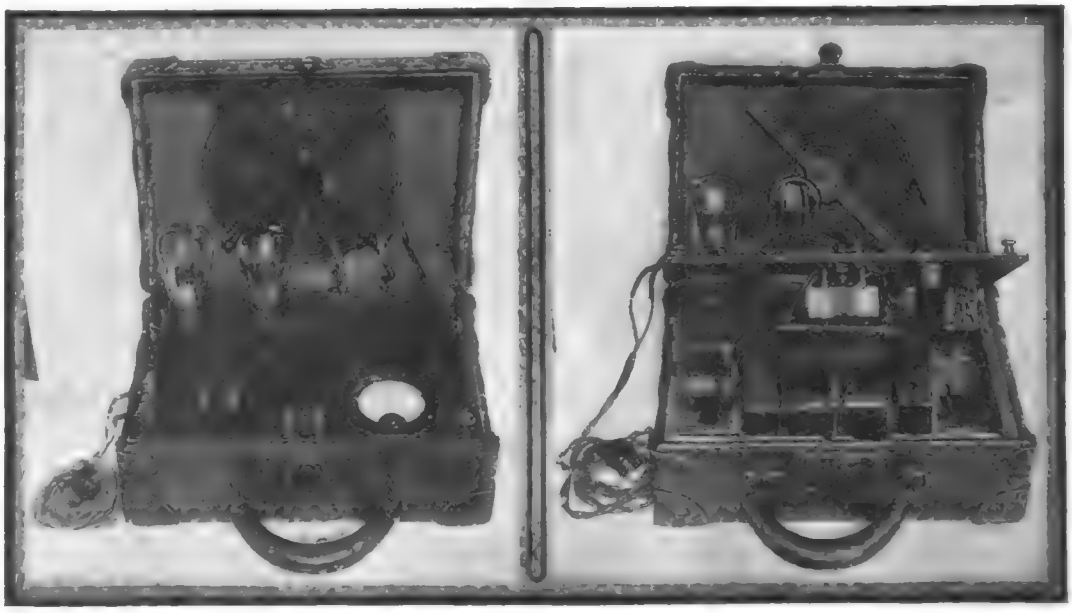
It should not be forgotten that present-day manufacturers design their units, upon scientific fundamentals, which require a knowledge of radio and higher mathematics, which is entirely unnecessary for the person who merely wants to use his station to communicate with some friend and cares but little about the underlying principles, so long as the communication can be established. Many of the manufacturers of today were the amateurs of yesterday. They know the way the amateur thinks and acts and make every effort to assist him.

There is very much less work to be done in connection with the installation of a modern wireless telephone station, than was necessary for the getting together of a most humble transmitter, a few years ago. Enough experimenting has been conducted to place the amateur in the enviable position of being able to profit by the good derived from the experience of others. So, when someone says, "Magnetic modulation," "Self-rectification," "Carrier wave," or the like, there is no need of imagining that none but those endowed with a superhuman intellect can comprehend radio and get a set to work properly.

A STEP IN THE RIGHT DIRECTION.

In order to actually demonstrate to the amateur the great simplicity with which a wireless telephone and telegraph set may be assembled and wired up, an electrical and radio supply company of New York City has taken a group of units, made up by a number of radio apparatus manufacturers, and assembled them upon a panel or base, making a complete set. The complete assembly is shown in one of the accompanying illustrations. It will be seen that it does not occupy very much room.

The antenna and earth connections, instead of being made to an antenna and earth, have been connected to an energy absorbing circuit, which is made up of the elements which the waves would have to overcome, in practical use. The wiring of the units has been accomplished with a view to permitting the wires to be followed without difficulty, so the patrons of the store may see exactly how the set is arranged. An effort has been made to do away with the "mysterious stuff" which surrounds C. W.



Photographs at Right Show a Very Compact, Continuous Wave, Vacuum Tube Transmitter Set for Radio-Telegraphy. All of the Transformers, Choke Coils, Resistances, etc., Are Enclosed in the Small Suit Case Shown, and It Can Be Operated from Any 110 Volt A. C. Circuit, by Means of the Plug and Cord Provided

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and duplication of this set by other dealers would enable them to secure the confidence of the amateurs, and the sales such confidence would bring about.

By referring to Fig. 1, and the accompanying list of parts, it will be a simple matter for anyone to secure the units and assemble such a set. It is almost possible to follow all the wiring in the photograph, so that will also be found of value.

In the list of parts it will be noticed that the motor generator, which is used to supply the plate current for the vacuum tubes, is a rather costly item. Where A. C. is available the motor-generator may be done away with and the units shown in Fig. 2, employed in its place. It will be seen that a few slight changes will have to be made in the circuit, but they are plainly indicated and no trouble should be found in putting the set together. Fig. 2 shows the wiring for a complete wireless telephone or C. W. telegraph transmitter, in which both the filaments of the vacuum tubes and the plates are supplied from separate windings on the same transformer unit, which does away with the motor-generator as well as the filament battery. When this circuit is used as shown, it is possible to use it for either telegraphy, by using the key and buzzer, shown in the circuit, or for telephony, by switching in the microphone. A comparison of the two circuits will indicate that they are nearly identical.

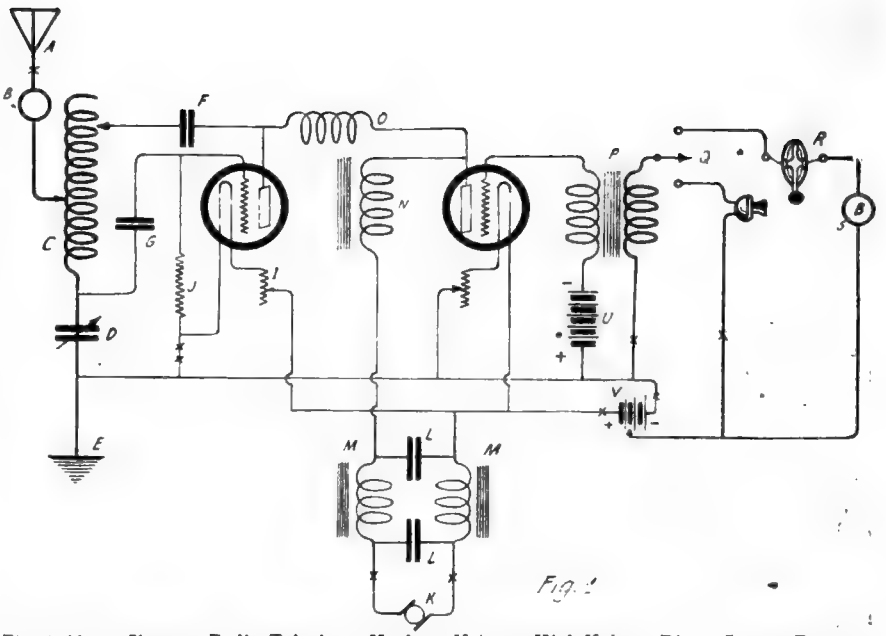

Fig. 1 Above Shows a Radio Telephone Hook-up Using a High Voltage Direct Current Dynamo.

Where the set is to be used only for telegraphy the simple circuit shown in Fig. 3, with the units on the accompanying list, may be relied upon to give very good results, if an A. C. supply is available.

SUBSTITUTION OF UNITS.

In the accompanying lists of parts equivalent units may be substituted, made by any reputable manufacturer where they have been designed to perform the same duty as those specified in the diagrams and specifications. For instance, there are a great number of grid-leaks on the market, any of which, if of the same resistance as the one in the circuit, will serve the purpose. By studying the conditions which any set is desired to work under, and the distance to be covered, where it is not in excess of thirty to fifty miles, one of the outfits indicated in the three diagrams should serve well, and should lend itself to fit in with the individual conditions, such as the amount of money which may be spent and the available power supply. Of course, from a comparison, it will be seen that one who has an A. C. supply running into his house or shop can install an outfit for less than where D. C. must be used. Where the amateur is desirous of obtaining a set with a greater range, it will be well for him to consult either his dealer or some good manufacturer, who will advise him.

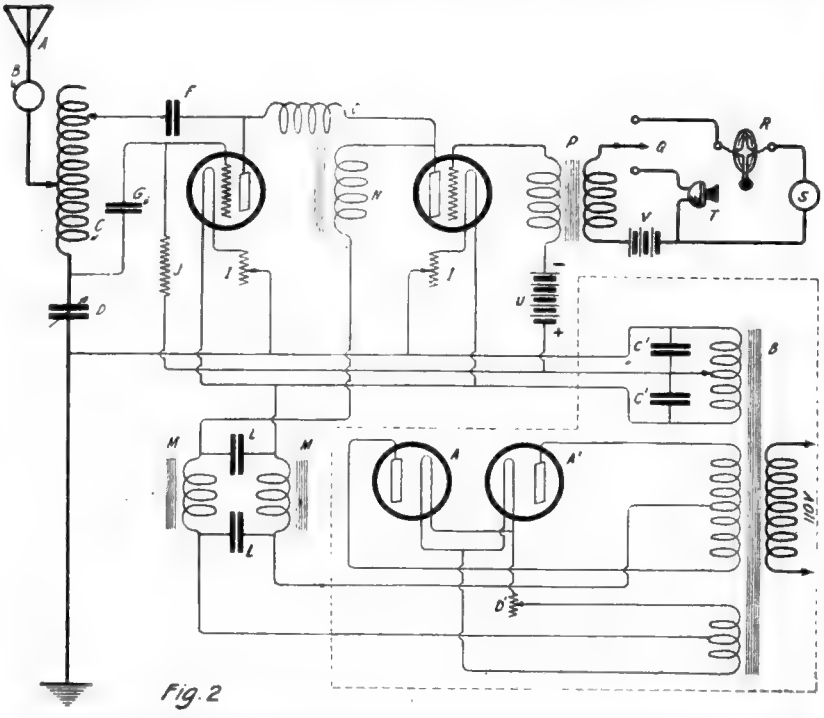

Fig. 2 Above Shows a Wireless Telephone Set Operated from Alternating Current by Means of a Transformer, B^1, and Two Rectifier Tubes, A and A^1 Connected Thru a Filter Circuit, MLML.

The circuits accompanying this article are intended to show the parts needed for securing specified results from certain conditions and must not be construed as a hard and fast rule for the purchase of the apparatus listed. The same unit, made by any other manufacturer, may be substituted in every case.

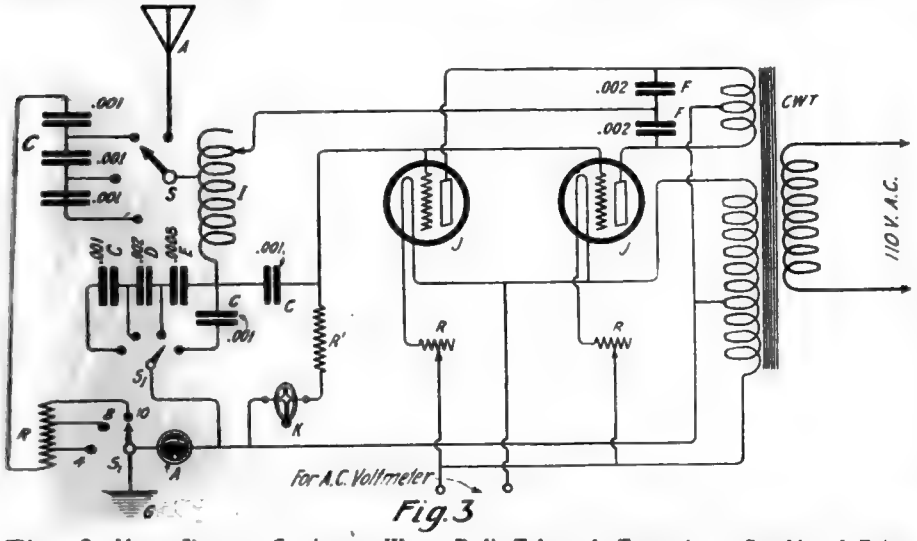

Fig. 3 Above Shows a Continuous Wave, Radio-Telegraph Transmitter, Capable of Being Operated from a 110 Volt A. C. Circuit. The Tube Filaments are also Lighted from the Special A. C. Transformer.

THE CIRCUITS IN BRIEF.

If all the units indicated in Fig. 1 are mounted on a board and wired as indicated, placing either a binding post or a Fahnestock spring connector at each place marked with an (X), it is a very simple matter to alter the circuit to correspond to Fig. 2, by adding the units included by the dotted lines.

The lead from the grid-leak (J), instead of being connected to the negative pole of the filament lighting battery (V), will be connected to the center tap of the filament lighting winding of the C. W. transformer (B^1).

The modulation circuit, instead of being energized by the filament lighting battery, (V), will be connected to any 4- or 6-volt supply, as indicated in Fig. 2. The end of the modulation transformer, thus left free, by withdrawing the filament lighting battery from the circuit, will be connected to the center tap of the filament lighting secondary of the transformer (B^1).

The motor-generator, indicated in Fig. 1, will be disconnected and replaced by the leads from the transformer secondaries,

(Continued on page 575)

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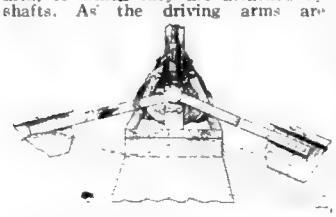
LATEST PATENTS

Wave Motor

(No. 1,385,083 Issued to Thomas A. McCulley.)

The operation of this invention is as follows: Floating buoys are caused to alternately rise and fall with each wave, thereby oscillating the driving arm, to which they are attached by shafts. As the driving arms are

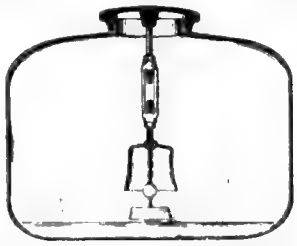


raised, upwardly-acting pawls engage the ratchet teeth upon a shaft, thereby imparting a rotative movement to the ratchets and gears. As the crest of the wave passes, and the buoy begins to descend, the downwardly-acting pawls engage teeth of the opposite ratchet, thereby causing rotation also. In practise the driving arms are of a length adapted to deliver the maximum power from one buoy, while the other buoy is inert at the crest or trough of a wave, thereby delivering maximum power from one or the other of each pair of buoys.

Audible Low Liquid Tank Alarm

(No. 1,381,299 Issued to William Grah.)

This signal can be used in almost any form of automobile gasoline tank to indicate when the liquid therein is running low. It is sounded by movements of the vehicle. It is suspended from the cap of a gasoline tank, and within the tank is a bell or gong, which may be attached to a sectional



rod having the sections connected by a turn-buckle to facilitate vertical adjustment of the bell or gong within the tank. A striker clapper is suspended within the resonant member, so that it can swing freely, and attached to the lower end of the striker is a float, which is movable up into the resonant member by a rising of the liquid level, and it thereby prevents the striker from swinging into striking contact with the bell. When the level of the liquid has lowered to a predetermined extent, the striker is free and thereby as the vehicle moves along, it will sound the alarm.

Submersible Amusement Device

(No. 1,384,750 Issued to Hugo Gernsback.)

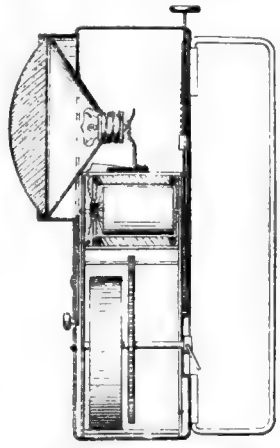
This invention was elaborately described in the June 1920 issue of this magazine. It comprises an open frame work wheel similar to a Ferris Wheel, except that it rolls upon a track mounted upon piles, as it passes from its land station into the water. The

speed down the incline is controlled by cables passing around sheaves mounted upon the wheel, and said cables are rigidly fixt at one end, and the other passes over drums, the rotation of which drums is controlled by motors; and thence is fastened to a counter weight, thus materially lessening the power required for returning the wheel to its former position. A safety device in the form of an abutment serves to check the downward movement should the cables break. The loading and unloading platform has several levels so as to hasten the loading and unloading of the cars. Each car is provided with water-tight doors, windows, and ventilators, automatically or manually controlled.

Flashlight

(No. 1,384,636 Issued to Arthur C. Sachse.)

This is a very clever flashlight device whereby it is possible to signal either a red or a white light. A casing provided with a concentrating lens is

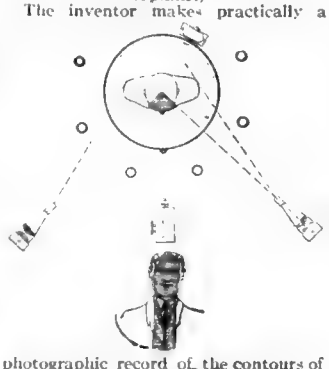


arranged with a reflector for properly projecting light. A red screen is mounted adjacent to this so that it can be pushed into operating position. A magneto generator is operated by a spring connected to it by a train of gears. This spring is adapted to be wound by means of a shaft having a toothed rack mounted upon one end and a seat upon the other end, whereby the operator depresses the rack. A concave finger grip upon this stem allows the spring to be wound up by movements of the rack, and then when it is further deprest, the finger grip releases the spring, causing the generator to be spun rapidly, and thus light the lamp.

Photo-Sculpture

(No. 1,382,978 Issued to Marcus C. Hopkins.)

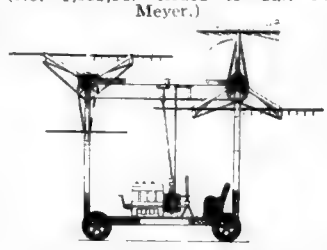
The inventor makes practically a



photographic record of the contours of the objects to be reproduced, such records being at closely adjacent planes. He preferably makes a three dimensional copy from the various two dimensional images, by tracing the images by means of a pantograph, causing a cutting tool to trace the contour line corresponding to each image, whereby, when all the lines have been traced, representing the complete circumference of the object, an original master copy will be secured, from which, after suitable retouching, it is possible to make any number of duplicate copies.

Airplane

(No. 1,382,847 Issued to Carl F. Meyer.)

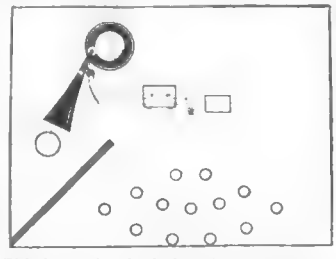


The inventor of this system mounts planes in such a manner that they are movable and rotatable about a given axis, but maintained in horizontal alignment. The series of aerofoils or planes are mounted upon rotatable spiders, the planes being adjustable so that they may be varied from horizontal to oblique angles. These planes are provided with unidirectional pliable or feathering areas so that the downward movement of one of them during its rotation is effective to lift the airplane, while the upward movement of this aerofoil does not retard the flying, due to its feathering action.

Apparatus for Recording and Reproducing Sound

(No. 1,383,737 Issued to James L. McQuarrie.)

If a diafram, such as is used in sound recording and reproducing mechanisms in connection with phonographs, is of the requisite degree of sensitiveness to respond most effectively to impulses from a given sound source, its response when these impulses are of a widely different intensity is apt to be defective.

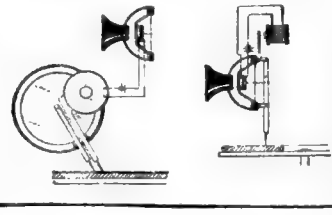


This invention is designed to overcome such defect by selectively supplementing the response of the diafram to the impulses. In one form of the apparatus, a diafram is mounted upon a support and connected to the diafram in the stylus. Associated with the diafram is a dampening member carried on a pivoted armature of an electromagnet and connected to a battery and a variable resistance. By changing this resistance the pressure of the dampening member against the diafram is changed. This is controlled either automatically or manually and provisions are made for both forms of control.

Method of Recording Sound

(No. 1,380,864 Issued to William H. Bristol.)

In order to give, in making phonograph records, a more complete and



natural record of music and also of a soloist's voice, the inventor of this system employs a transmitter, into which the strains of music from the orchestra enter, and which produce electrical impulses, and the impulses thus resulting are in turn transmitted to a thermionic amplifier of the audio-frequency type, whereupon impulses of sufficient intensity are provided, and are caused to affect the recording mechanism simultaneously with a voice from the solo singer. The soloist is placed near the mouth of the horn and the orchestra may be 35 or 40 ft. away and insulated as far as sound is concerned, from the phonograph and the soloist. In this manner entire symphonies can be employed in the making of phonographic records.

Photo-Electric Cell

(No. 1,381,474 Issued to Jakob Kunz.)

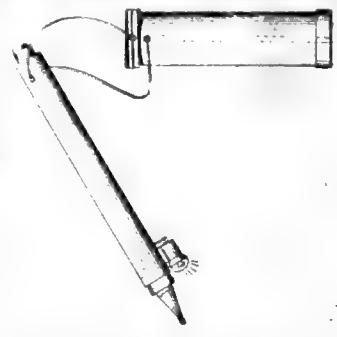
The inventor of this photo-electric cell provides for an evacuated glass chamber having two electrodes, one

of which consists of a dense film of an alkali metal lying on the inner surface of the chamber. The chamber is filled with hydrogen or an inert gas such as nitrogen, argon, helium, or neon. The other electrode is placed immediately in the vicinity of the film electrode and is preferably in the form of a screen lying in the path of the light to the cell, yet at the same time obstructing as little light as possible. Between these two electrodes there is formed a field subject to and sensitive to the influence of light.

Illuminated Pencil

(No. 1,381,763 Issued to Ferdinand Stritinger and Rudolph Miller.)

This is a very compact pencil or similar writing instrument, which is



so arranged that the paper upon which the individual is writing can be illuminated very easily. The lighting device is mounted upon a tubular member constituting a support or holder for receiving conventional types of pencils, and a novel type of circuit closer conveniently operated by the finger of the operator in writing, places the light under his direct control.

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Scientific Humor

Braking It Gently.—Inquisitive Old Gentleman at Airplane Field.—"What kind of brakes do they use on airplanes?"

Aviator.—"Air brakes, of course."—*Edwin Mikesell.*

By Gum; He's Right.—Little Jimmy watched his mother very interestedly as she dropt the coin in the slot of a street-car's fare collector, and then looked puzzled.

"Where's the chewing gum, mama?" he asked innocently.—*R. Essery Geddes.*

And Smell Vile.—Riggs: "All automobiles have the tobacco habit."

Jiggs: "How is that?"

Riggs: "Well, some smoke and all use a plug."—*Wm. R. Reinich.*

On Their Noses?—She: "An Italian inventor has perfected a new luminous paint."

He: "No doubt the ladies will shine more than ever now."—*Ernest T. May.*

Privately Conducted.—Prof.: "What is a good conductor of electricity?"

Student: "Telephone Poles."—*Louise Probst.*

And Plenty of Stars.—Willy: "I'm studying astronomy, you know."

Billy—"Well, what do you know about the sun, moon or stars?"

Willy—"Oh, every time father reaches for his strap it is a sure sign that there will soon be 'spots on the son (sun).'"—*Anthony Rogers.*

Unless She's Out of Sight— Tommy: "Pop, what is the difference between vision and sight?"

Tom's Pop—"Well my son, you can flatter a girl by calling her a vision, but never call her a sight."—*John F. Krebs.*

If It Only Could Be Done. — Rubber: "Why is the Joke Editor having an X-ray machine installed in his office?"

Neck: "He wants to look thru the jokes he receives."
—*Michael Russo.*

In the Year 2000—Doctor to patient: "Does that monkey blood transfusion make you any livelier?"

Patient: "Yes, but every time my hand itches I have to scratch my foot to get relief."—*J. J. Rogers.*

He Knew His Physics.—Young Man: "Dad, I'm going to look for a new job."

Father: "Son, don't you know a rolling stone gathers no moss?"

Young Man: "Yes Dad, but it gathers momentum every second."—*Jas. G. Kyfer.*

Decorated Sufficiently.—"Say, Pa, this magazine says Mme. Curie got another medal for discovering radium. Why didn't my Ma ever get a medal?"

"Why should she? She meddles enough as it is."—*E. Blake Whiting.*

First Prize, $3.00

Alarming Situation. Excited Professor (telephoning: "Hello, is this the Fire Department:

Fire Department: "Yes, what do you want?"

The Professor: "Please tell me where the nearest fire alarm box is to my house. My laboratory is on fire so I must know immediately."
—*Junior Zahn.*

Under-Developed.—He fell in love with her photo and asked her for the original.

But it developed that she gave him the negative.—*John Krebs.*

He Made No Bones About It.—Will: "If I were a doctor I'd specialize in bone surgery."

Bill: "You've got a good head for it."
—*F. D. Hensel.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

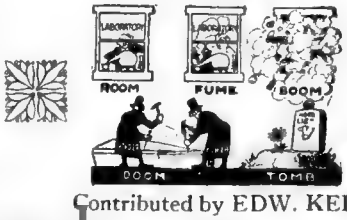
Took On Too Many Airs.—Gusty: "See where you sold out your aero business."

Dusty: "Yep, too big an overhead."—*D. C. Wilkerson.*

Did He Get Her.—He, Instructively "The denser the medium through which it passes, the better sound travels. Do you understand, Dear?"

She, Innocently—"Is that why you can hear so much better than I?"—*Elsie P. Scott.*

Room for Glume.

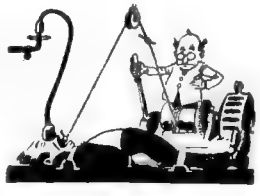


Contributed by EDW. KEHL, Jr.

De-Lighted.—Rev. Dr. Fourthly was reading the evening lesson from the Book of Job, "Yea, the light of the wicked shall be put out." Just then the lights happened to go out. "Brethren," said the minister "in view of the startling fulfillment of this prophecy, we shall spend a few minutes in silent prayer for the electric light company."—*H. E. Zimmerman.*

How Come Luke?—Prof. of Chemistry: "Define the symbol HCl."

Student: "High Cost of Living."—*Isaac Margolis.*



It Never Rains but It "Pores." — A wild looking individual rushed into the dentist's office and confronted him with: "Do they give a fellow gas here? Honest, now, tell me."

"Yes, sir," said the dentist.

"Can a fellow feel anything at all when he takes it?"

"No."

"Well, I'll take it."

"All right, sir; which tooth?"

"Tooth be hanged! I want you to take off a porous plaster."—*N. C. Ogilvie.*

The "M. D." Up-to-Date.—Mrs. Dowager—"I can't sleep, Doctor; in spite of everything I do, I can't sleep."

Dr. Up. N. Cumming—"Try taking a glass of warm milk and a little scraped apple just before going to bed."

Mrs. Dowager—"But, Doctor, six months ago you told me to go to bed fasting."

Dr. Cumming—"I know, my dear Mrs. Dowager, but that was six months ago. Medical science has made tremendous strides since then, you know."
—*Geo. F. Forster.*

He's Lucky. Ours Is Full of Misses—Salesman: "Have you a little Fairy in your home?"

Motorist: "No, but I have a little miss in my engine."—*Francis E. Gredell.*

Relatively Correct.—Prof. (to elevator boy): "Young man, have you ever read Thomas A. Edison's questions?"

Elevator Boy: "Yah, so did Einstein, that's why he left the country so quick."
—*Herbert Mueller.*

From a Canadian Newspaper

Reward.

FOUND—A BULL DOG. WILL EAT anything, very fond of children. Owner can have same by calling at store. J. M. Card and Company

FOUND—A GOLD BROOCH. M

Contributed by CLAYTON J. PETERSON.

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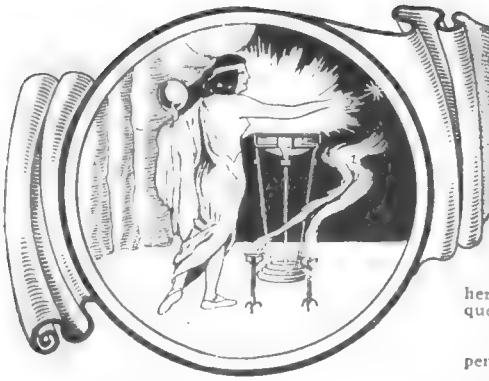

THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answere here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under whic questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, n penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to this department car not be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable researc work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Perpetual Motion Machines

(1140) Lou Nauman, Portland, Ore., asks:

Q. 1. I have what I think is a perpetual motion machine. Is such a thing possible?

A. 1. In our opinion, "perpetual motion" exists today only in planetary movements, etc., but up to the present time there has been no machine devised which will give perpetual motion and we do not believe there ever will be. All such machines work very well on paper, but always some fault or defect can be discovered and the practicability of the machine can be refuted by simple mathematics.

If you have a machine actually constructed which gives perpetual motion, you have worked wonders, which no inventor heretofore has been able to do.

Welding Transformer

(1141) B. E. Lewis, Miami High School, Miami, Arizona, writes:

Q. 1. Please give me data on a small welding transformer.

A. 1. Iron core 15 inches long, 8¼ inches wide, made of laminated iron 2 inches thick, made like a picture frame; on one side it is wound with 13½ pounds or 344 turns of No. 10 B. & S. gauge D. C. C. Wire.

The secondary coil is wound with 31 turns of No. O. B. & S. gage D. C. C. wire or two No. 3's in parallel or four No. 6's in parallel. Consumption is 11c. at 10c. per K. W. H. on a 110 volt, 60 cycle A. C. circuit; transformer takes 10 amperes in primary winding and 110 amperes, 10 volts in secondary winding.

Electricity and the Body

(1142) M. H. Berry, Seattle, Wash., writes:

Q. 1. Does electricity from a violet ray generator pass thru the system or only act superficially? Some electrical engineers, whom I have discuss this subject with, state that if the shock penetrated deeply, reaching the heart, it would be sufficient to kill the person.

A. 1. Electricity from a violet ray generator does not pass thru the body, but is entirely superficial in its action. This is so with nearly all high frequency currents.

There is no reason to suppose, however, that when once a current reaches the heart, it will kill the individual, as medically, we know that the heart communicates via nerves, nerve centers and plexuses with every part of the body, having its own nerves within its substance for regulating the valvular actions; hence stimuli applied to the body will indirectly have an effect upon the heart, but the effort is so slight, that no disturbing action will be noted, due to the heart's compensatory system.

If the current is applied at such a high pressure, however, that a powerful shock is given to the nervous system, it will cause such a reflex inhibitory action on the heart, as to slow it down and cause it to cease beating. No cases on record show lesions or burning of the heart, where criminals have been electrocuted. Refer to the February, 1921, issue of this journal, where the physiological effects of electrocution of criminals are given.

Making Paper Transparent

(1143) Erwin Studer, Chicago, Ill., asks:

Q. 1. How can I make paper transparent?

A. 1. You can make paper transparent by using either a wax or an oil, or if you use kerosene you will find that the kerosene will evaporate, leaving the paper pure white, by heating the paper in an oven.

Here is a good formula for making the paper very transparent. Dissolve very fine white glue in distilled water and apply the solution smoothly and evenly over the face of the picture, using a broad flat camel's hair brush for applying it. Now lay the paper face down on a sheet of glass and press firmly; when dry the paper will be quite transparent.

Specific Time Circuit Closer

(1144) Earl Cochran, Poplar Bluff, Mo., writes the Oracle:

Q. 1. How can I close a circuit when exactly 40 coulombs of electricity have past thru it?

A. 1. There are several ways of opening or closing a circuit when the current from a four-volt battery has delivered a value of 40 coulombs. The simplest is by way of a watt-hour-meter which will automatically make contact by one of the hands and open the circuit by a relay. Another way is to have a long tube of glass balanced on pivots, two metal plates at either end. The current passes thru a silver cyanide solution in which these plates are immersed. If a very sensitive balance is now established and sufficiently weighted at the other end, it will be found that in any solution of silver .001118 gram of silver will be deposited upon one plate for each coulomb. When the plate therefore becomes heavier on one side, it will automatically tip the balance and close the circuit. These plates could also be immersed in a solution, suspended from a delicate balance, and sufficient weight added to one scale pan to overcome any slight additional deposit until the desired weight is reached.

Is Venus More Advanced Than the Earth?

(1145) S. I. Crown, Montreal, Canada.:

Q. 1. Since scientists claim intelligence on Mars is higher than on Earth for the reason that Mars is an older planet, therefore intelligence on Earth must be higher than on Venus, because Venus is a younger planet. But, perchance, intelligence may have taken a longer time to form on the planet Mars and altho the Earth is a younger planet, it is possible intelligence started on our sphere before it started on Mars. The Earth would therefore be farther advanced intellectually than Mars. Also, altho Venus is a younger planet than our globe, intelligence may have started on Venus sooner than on Earth, then the Venerians would be farther advanced intellectually than we Earth people. Is this not within the realm of possibility?

A. 1. There are so many things within the realm of possibility that it would be very foolish for us to condemn your idea, altho it is very probable that Mars, being an older planet, would naturally be further advanced intellectually than the earth.

It seems that intelligence starts at a certain definite period with the beginning of population gradually advancing. Thus, the Indians who probably did not know anything about the other hemisphere, knew all about fires, how to start them, etc., and how to cultivate corn and other useful foodstuffs, as did those of the eastern hemisphere.

Modern science, however, contends that the Indians and other inhabitants of this hemisphere were affiliated in some way with inhabitants of the old hemisphere, because of the marked similarity in monuments, etc. Whether or not there was a passage between the two hemispheres at the Bering Strait, has not been definitely established. Nevertheless, there is a remarkable difference between the two sets of inhabitants which seems to strengthen the contrary view, and altho Venus may be further advanced intellectually than the earth, or Mars, it is not generally so considered among scientific people.

In addition, Venus is a much more difficult planet to observe because of the tremendous clouds perpetually surrounding it. Your idea suggests considerable improbabilities, but it has been suggested before, seemingly thoroly thrashed out, but this theory has been practically discarded at the present day.

Inventions Wanted

(1146) J. H. Jobson, M.E., Holly Crest Garage, Mentone, Ala., asks this Department:

Q. 1. Where can I get a list of inventions wanted?

A. 1. Many patent attorneys supply a list of inventions desired, which is free to anyone who will request the same. We would advise you to write to the advertisers in our magazine, in reference to the same.

Q. 2. Has a successful walnut branding machine been built?

A. 2. To the best of our knowledge, a machine to brand walnuts has not been successfully constructed.

Cartoon Movie of Gasoline Engine

(1147) Sigmund W. Leifson, North Dakota, inquires:

Q. 1. Who made the cartoon movies of a gasolin engine in action and where were they made?

A. 1. Cartoon movies showing the action of gas engine in operation were made by Burt Gree of the Pathé Studio, No. 1 Congress St., Jersey Cit N. J.

Q. 2. Why don't we have more strictly scientif films?

A. 2. It may be that a real strictly scientif film will soon be placed on the market, embodyir the new devices and methods found in SCIENCE INVENTION MAGAZINE, all worked out, with tl parts shown working.

Scientific movies are not in popular favor with tl majority of people, who want to be amused. Abo 90 per cent of the theatergoers want comedy and lo of it. They would rather spend two hours lookir at Charlie Chaplin than five minutes watching film presentation showing how their automobi engine works. That is why the demand from mov theatre managers for science films is very slight.

50-Watt Transformer Data

(1148) Jesse H. Logan, San Antonio, Texa writes:

Q. 1. I have an iron core as shown in my sketcl Please give me data on a 50-watt transformer.

A. 1. On the primary of your coil, we woul advise that you wind 480 turns of No. 22 D. C. C magnet wire. On the secondary, wind 50 turns o No. 16 D. C. C. magnet wire, with a tap taken ol every 14 turns.

At 10 cents per kilowatt hour, the cost of operatio of this transformer unloaded will be 1/12 cent pe hour. Under full load, the cost will be about cent per hour.

Airplane Data

(1149) Hilton F. Lusk, Oakland, Calif., writes

Q. 1. What is a good book on airplane stresses?

A. 1. One of the finest books giving data on stresses and strains on various portions of airplane construction, is a recent book called "The Aeroplane," by Bedell. The price of the same is $3.00 and it can be purchased from our book department.

This book contains all the vital data necessary for such calculations and gives many interesting phases of airplane construction.

Q. 2. What aluminum alloy is used in aircraft that is lighter than aluminum?

A. 2. Aluminum alloys are sometimes composed of magnesium and aluminum. It is claimed that such composition is as strong as steel and yet 25 per cent lighter than aluminum itself.

Post-Card Projector

(1150) Earl Lyton, Webster Groves, Mo., asks:

Q. 1. I have a postcard projector and am using a reading glass lens. Is this all right?

A. 1. If a good quality it will answer y purpose. If not perfect it magnifies only slig It may act very well, provided the distance t screen is quite large.

Single lenses are generally used for post-card jectors.

Chemical Queries

(1151) Druitt Latus, Pittsburgh, Pa., writes:

Q. 1. How can I make diamond ink?

A. 1. In order to make diamond ink, we give herewith two formulas. 1—Ammonium fluoride, one ounce; barium sulphate, three ounces, sulphuric acid, enough to make a paste. 2—Ammonium Fluoride, two ounces; barium sulphate, two ounces, hydrofluoric acid, enough for semi-liquid; writing being accomplished by the use of either platinum wire or a gold pen, the latter being used after the ink is diluted, one-half with water.

Q. 2. How can I make luminous paint?

A. 2. A good many luminous paints are based on radium salts, because of their ability to give off light to a marked degree, without the necessity of submitting them to the action of sunlight. Here is one which gives a beautiful phosphorescent color. 100 parts by weight of strontium carbonate; 30 parts sulphur; 2 parts sodium carbonate; .5 parts sodium chloride; 2 parts manganese sulphate.

These materials are heated for three-quarters of an hour to one hour at a temperature of 1,300 degrees, C.

Q. 3. What is the boiling point of alcohol?

A. 3. Boiling point of alcohol, 78.4 degrees centigrade.

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How I Increased My Salary More Than 300%

By JOSEPH ANDERSON

I AM just the average man—twenty-eight years old, with a wife and a three-year-old youngster. I left school when I was fourteen. My parents didn't want me to do it, but I thought I knew more than they did.

I can see my father now, standing before me, pleading, threatening, coaxing me to keep on with my schooling. With tears in his eyes he told me how he had been a failure all his life because of lack of education—that the untrained man is always forced to work for small salary—that he had hoped, yes, and prayed, that I would be a more successful man than he was.

But no! My mind was made up. I had been offered a job at nine dollars a week and I was going to take it.

That nine dollars looked awfully big to me. I didn't realize then, nor for years afterward, that I was being paid only for the work of my hands. My brain didn't count.

The Story of a Man Just Like Myself

THEN one day, glancing through a magazine, I came across the story of a man just like myself. He, too, had left school when he was fourteen years of age, and had worked for years at a small salary. But he was ambitious. He decided that he would get out of the rut by training himself to become expert in some line of work.

So he got in touch with the International Correspondence Schools at Scranton and started to study in his spare time at home. It was the turn in the road for him—the beginning of his success.

Most stories like that tell of the presidents of great institutions who are earning $25,000 and $50,000 a year. Those stories frighten me. I don't think I could ever earn that much. But this story told of a man who, through spare-time study, lifted himself from $25 to $75 a week. It made an impression on me because it talked in terms I could understand. It seemed reasonable to suppose that I could do as well.

I tell you it didn't take me long that time to mark and send in that familiar coupon. Information regarding the Course I had marked came back by return mail. I found it wasn't too late to make up the education I had denied myself as a boy.

It Was All So Easy, Too!

I WAS surprised to find out how fascinating a home-study course could be. The I. C. S. worked with me every hour I had to spare. I felt myself growing. I knew there was a bigger job waiting for me somewhere.

Four months after I enrolled my employer came to me and told me that he always gave preference to men who studied their jobs—and that my next salary envelope would show how much he thought of the improvement in my work.

Today, my salary is more than 300% greater than it was when I began my studies. That increase has meant a better home and all the luxuries that make life worth while.

What I have done, you can do. For I am just an average man. I had no more education to begin with than you have—perhaps not as much. The only difference is a matter of training. Yes, a matter of training.

How much longer are *you* going to wait before taking the step that will bring you advancement and more money?

Are You Earning Less Than $75 a Week?

TO every man who is earning less than $75 a week, I say simply this:—*Find out what the I. C. S. can do for you!*

It will take only a minute to mark and mail the coupon. But that one simple act may change your whole life.

If I hadn't taken that first step four years ago I wouldn't be writing this message to you today! No, and I wouldn't be earning anywhere near $75 a week, either!

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6205-B SCRANTON, PA.

Without cost or obligation please explain how I can qualify for the position, or in the subject *before* which I have marked an X in the list below:

☐ ELECTRICAL ENGINEER	☐ BUSINESS MANAGEMENT
☐ Electric Lighting and Railways	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING
☐ Telegraph Engineer	☐ Show Card & Sign Painting
☐ Telephone Work	☐ Railroad Positions
☐ MECHANICAL ENGINEER	☐ ILLUSTRATING
☐ Mechanical Draftsman	☐ Cartooning
☐ Machine Shop Practice	☐ Private Secretary
☐ Toolmaker	☐ Business Correspondent
☐ Gas Engine Operating	☐ BOOKKEEPER
☐ CIVIL ENGINEER	☐ Stenographer & Typist
☐ Surveying and Mapping	☐ Certified Public Accountant
☐ MINE FOREMAN or ENGINEER	☐ TRAFFIC MANAGER
☐ STATIONARY ENGINEER	☐ Railway Accountant
☐ Marine Engineer	☐ Commercial Law
☐ ARCHITECT	☐ GOOD ENGLISH
☐ Contractor and Builder	☐ Common School Subjects
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Concrete Builder	☐ Railway Mail Clerk
☐ Structural Engineer	☐ AUTOMOBILES
☐ PLUMBING & HEATING	☐ Mathematics
☐ Sheet Metal Worker	☐ Navigation
☐ Textile Overseer or Superintendent	☐ AGRICULTURE
☐ CHEMIST	☐ Poultry Raising ☐ Spanish
☐ Pharmacy	☐ BANKING ☐ Teacher

Name .....

Street and No. .....

City ..... State .....

Occupation .....

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YOUR TROUBLES ARE OVER

Three miles an hour on level ground and forty miles an hour up the hill. Van Kerr Transformers enable you to do both these things "in high."

Van Kerr Transformers

Decrease gasoline consumption — give greater power—reduce carbon deposits. They can be attached in a few minutes, and from that time on you will have a sweet, smoothly running motor which starts easily even in zero weather.

Does Your Motor Pump Oil? Don't Worry!

Van Kerr Transformers will overcome the troubles due to this condition. The intense hot flash at your plug points, due to our patented, fireproof, open air gap, explodes every particle of oil and gas, giving greater power, leaving no carbon and permitting the use of a leaner mixture. There is no necessity of having your cylinders rebored, or installing new piston rings. Van Kerr Transformers instantly remove the difficulties caused by motors pumping oil and insure against fouled plugs and carbonized motors.

For pleasure cars, motorcycles, tractors and gas engines

We Will Send You a Set of Transformers

by parcel post. Write us today and tell us your dealer's name and the kind of car you drive. Send no money. Simply pay the postman $2.00 for a four-cylinder set or $2.50 for a six-cylinder set. Use them ten days and if you are not satisfied that they do all we say they will, return them and you will get your money back.

The Van Kerr Co., Dept. 683, 3160 N. Clark St., Chicago

Over 100,000 satisfied customers are using Van Kerr Transformers

Attach them yourself. All you need is two minutes and a pair of pliers

Tires at Half Price

This direct-to-consumer plan enables you to save 50% to 60% on your tire bills. Our process of reconstruction makes our tires one of the best buys on the market today.

Brand New Standard Tube FREE With Every Tire Ordered

30x3	$6.30	33x4	$10.40	35x4½	$12.65
30x3½	7.40	34x4	10.75	36x4½	14.00
32x3½	8.35	32x4½	11.50	35x5	13.85
31x4	9.60	33x4½	11.90	37x5	14.30
32x4	9.95	34x4½	12.40		

We will ship tires same day as ordered. Examine carefully and if satisfied, pay expressman. State S. S. or clincher, plain or non-skid as desired. Send $2.00 deposit with each tire ordered. Balance C.O.D.

PEERLESS TIRE SALES CO., Dept. 537
2108 South Racine Avenue, Chicago

SPECIAL DISCOUNT

MULTI-CORD TIRES

Built for 6000 Miles Service—Standard adjustment to govern

Our dependable process of reconstruction doubles the life of the tire and represents a saving which you cannot afford to miss.

A New Standard Tube Free With Each Tire Ordered

30x3	$6.80	31x4	$10.10	32x4½	$12.00	36x4½	$14.00
30x3½	7.90	32x4	10.45	33x4½	12.40	35x5	14.35
32x3½	8.85	33x4	10.90	34x4½	12.90	37x5	14.80
S.S. or Clincher		34x4	11.25	35x4½	13.15		

Orders shipped same day received. Send $2.00 deposit with each tire ordered, balance C. O. D. Tires shipped subject to your examination. State whether SS or CL, plain or Non-Skid is desired. All same price. By sending full amount with the order you can save 5 per cent—our special cash with order discount.

RACINE TIRE SALES CO., Dept. 1085 2108 So. Racine Ave., Chicago

STAMMER

If you stammer attend no stammering school till you get my large FREE book entitled "STAMMERING, Its Origin and the Advanced Natural Method of Cure." Ask for special tuition rate and a FREE copy of "The Natural Speech Magazine." Largest and best school for stammerers in the world. Write today. The North-Western School, Inc., Milwaukee, Wis.

"BOW LEGS and KNOCK-KNEES" UNSIGHTLY

Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.

PERFECT SALES CO.
N. Mayfield Ave., Dept. 50, Chicago, Ill.

The Record-less Phonograph

(*Continued from page* 542)

the instrument and pointed to a corner. "Just an audion," he said, "and a small storage battery, and a specially constructed diafram. Of course on our system we dispense with such attachments to the cabinet, these details being part of our equipment in the record room. But I believe the record is the thing in which you are most interested."

"Yes, let's hear about it," I replied. "I'm suffering for want of enlightenment."

"Perhaps, I would be more easily understood," he said, "if I should tell you something of my line of reasoning. Now just because the first phonograph used a record with grooves, for a needle to follow, by which vibrations were picked up, it does not follow that a grooved record is the one and only way of recording and reproducing vibrations.

"Why do we use such means of recording and reproducing vibrations, when the records are likely to become scratched, cracked and broken? These are decided disadvantages," he continued, "and you can't turn your phonograph on its side or upside down and expect it to run, for the tonearm slides across the record or falls away altogether. Suppose you wanted a phonograph playing as a part of a street demonstration, the instrument being conveyed on a truck. The slighest jar is likely to throw the needle from its position on the record."

I remembered that while watching the testing of a phonograph in the old Wassenbach factory, a workman pounding nearby caused the needle to jump several times to new positions on the record.

Wassenbach continued, "The only way to overcome these disadvantages is to have the vibrations induced, in some manner instead of depending upon direct contact. Now, we know how the molecules composing a piece of metal move among themselves when subjected to stress. We know that when a piece of iron is placed near a strong magnet, something takes place in the iron; a condition exists that did not exist before. Suppose then, that we impart a vibration to the iron while under the influence of the magnet. Some of these molecules will respond readily to the vibration. At that particular instant another condition exists that did not exist before. The molecules are under the influence of both vibration and magnetism. And here is where still another influence is needed—I have been working on it for years and have finally perfected it—the *third influence* I call it, to which the metal is subjected while under the other two influences, which has the peculiar effect of holding the molecules in the particular condition effected by the vibration—'kills them,' we may say, for want of a better term, after which they are unable to act, and of course, do not return to their normal position after the influences are removed."

"Very good," I ventured, "but what is going to prevent these vibrations getting mixed up?"

"That is the reason," he replied, "that our record is to make one revolution during the recording and the reproducing of a selection. As fast as the vibrations reach the record and are permanently fixt there by our *third influence* the record has turned a trifle, the magnetic influence is in a slightly different direction and other molecules are being affected and permanently fixt by other vibrations, similar to those that have gone before. So the piece

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of metal you held a while ago was not an ordinary piece of metal. You will notice it is no longer attracted by a magnet, no matter how strong the attraction, tho it responded readily to the magnetic influence before and during the time the record was made, gradually losing its attraction as the revolution was being completed."

Wassenbach turned his attention again to the machine. "Now about the reproducing device. The diafram is much the same as a telephone receiver, and is connected with an audion as you have noticed. But I suspect you are more interested in the method of picking the vibrations off of the record."

I nodded. "You will notice," he continued, "that instead of a needle and tone arm being affixt above the record, we have a thin loop of steel wire reaching over the record from the edge, extending about an inch toward the center."

"But I see more than one loop," I put in, "there are a dozen at least."

"Yes, there are twelve," he said. "Each of these loops, if they were connected with the regular system, would lead to a separate home. At the record room we have a hundred loops to a record. That means that one hundred patrons need only one record of any selection, and all may play it at one time."

"Well," I said, "what are the other advantages of the darned contraption?"

"First, the cost," he replied. "Fifty to a hundred dollars, depending upon the finish desired, to install in the home. Five dollars a month, after that for the service and a catalog out of which to choose selections. Just at present our catalog contains some six thousand numbers—quite a variety at five dollars a month. The records are running at all times except from four to six in the morning when necessary changes or repairs are made. There is little difference in the cost of operation whether a record is used much or little. This against the cost of the old type phonograph, say one hundred and fifty for the machine and a hundred or two for an assortment of records. You see the advantages, don't you, Carson?"

"Just as you like," I said, "When do I get a peep at that record room?"

A ten minute ride in Wassenbach's runabout brought us to a large brick building which was once used by the telephone company, but now devoted to the operation of thousands of phonograph records. Entering thru a side door we past down an aisle on each side of which were tall vertical shafts upon which the records, about ten inches in diameter and four inches apart on the shaft, were slowly revolving.

"Are some of these records playing now?" I inquired, for I detected not a sound.

"Certainly," he replied, looking more closely at a few of the records nearest him, "Though of course you can't hear a sound. The current goes to the audions where it is amplified many times as it is being reproduced in the separate cabinets. Here is one that is playing," he said, "and there is one being used by five patrons at this minute. Come with me."

I followed between other rows of records. Wassenbach stopt and indicated with a gesture a few shafts at the end of a row.

"Here are the records most used," he said, "the latest and most popular selections. See those two records? I have purposely placed them on the shaft for observation. This one is running in sixty-five homes at this minute and that one is causing cheer and gladness in eighty-one

(Continued on page 546)

How to repair and take care of Dynamos and Motors.

Armature winding and construction of Dynamos and Motors.

Planning and Installing Lighting Systems in Houses, Stores, Factories, Theatres, etc.

How to be a successful inventor and experimenter.

All about alternating current machinery, transformers and switchboards.

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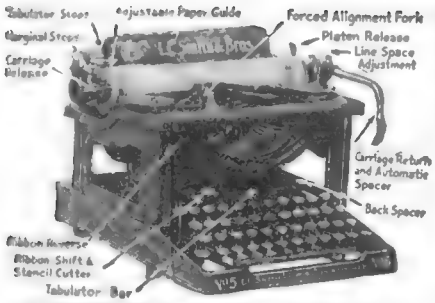

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The Record-less Phonograph

(*Continued from page* 545)

more. These are the records that start annoying the neighbors early in the morning and keep going till the small hours of the following day."

"Do you make your own records," I asked.

"No, I have enough to do in my experimental laboratory," he said, "though the manufacturers are co-operating with me in every possible way to develop the system. It's a good proposition. The patent rights are well protected, and when I get it going properly—well, perhaps I'll get at something else."

No doubt he will. In a few years I will probably see Wassenbach again, and will be thoroughly disappointed if he is not engaged in developing "something else" equally strange.

The Amateur Magician

By JOSEPH H. KRAUS

(*Continued from page* 527)

He produced a half dollar coin and requested that I mark the same, so that I would be able to identify it again. "Did you ever see a coin rubbed into the elbow?" he continued. "No? Well, watch closely." So saying he proceeded to rub the coin seemingly into his elbow. The first time it did not succeed, for he clumsily dropt the coin on the floor. He tried again and rubbed vigorously and then showed both hands empty. He then requested that I extract the half dollar which was protruding from his collar. I did so.

"Did that fool you?" he added. I had to admit it did. "Well," he explained, "the stunt is very simple. I rubbed the coin into my right elbow or so it seemed, and dropt it the first time, not accidentally but purposely. I then pick the coin up with my right hand and seemingly transfer it to my left hand, but in reality retain it in my right hand. I rub again and while the left hand is doing the rubbing, the right hand is inserting the coin into the collar. Simple?" "Yes, it certainly was simple," I admitted.

THE DANCING PLAYING CARD

"Now, let me have one of those cards if you please and your straw hat." He took the card I handed him and placing it upon my hat balanced it in an upright position. I was speechless. "It does look hard, doesn't it, but it's not. You see I have a blonde hair about 17" or 18" long attached to the button of my vest. At the other end of this blonde hair is a tiny pellet of wax. When you gave me the card I secretly fastened this pellet of wax to the back of it and then standing the card upon your hat so that it tilted toward you slightly, I was able to hold the card in this position and even tho you are but a few feet away, you couldn't see the hair.

THE MOVING RING TRICK

"Your ring, please." I again complied with his request. He took a pencil from the drawer in the table and then passing the ring over the top of the pencil, said, "Now watch it."

"Up," and the ring rose upward on the pencil. "Down," was his command, and it fell down. "Now, you tell it to do something." I commanded the ring to go up; instead it went down. I commanded it to go down, and it went up. "You see it is operating exactly opposite

(*Continued on page* 572)

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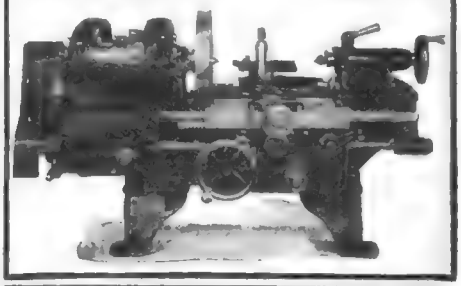

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Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page* 530)

meant by *endpoint*, mount two 50 cc. burettes as shown in Fig. 1. Place in one a dilute solution of hydrochloric acid and in the other a dilute solution of sodium hydroxid. Under each burette place a piece of white paper. Have at hand a glass stirring rod and a wash bottle. Opening the stopcock of the burette carefully, allow about 10 cc. of the acid to flow down the glass rod into the beaker placed upon the square of white paper. With the glass rod remove the drop of acid that clings to the stem of the burette and with the wash bottle carefully wash down the sides of the beaker and wash off the acid from the stirring rod, but do not remove the rod from the beaker. See Fig. 2.

Now place the beaker under the sodium hydroxide burette and introduce a drop or two of *phenolphthalein indicator*. Then add sodium hydroxid slowly and with constant stirring until the pink color appears. Wash off the sides of the beaker and the stirring rod, and replace the beaker under the acid burette. Introduce the acid a *drop* at a time until a single drop will decolorize the solution. Do not forget to remove the drop that clings to the stem of the burette each time nor to rinse off beaker and stirring rod. Next place the beaker under the sodium hydroxid burette again and introduce the solution of the base, a drop at a time, until a single drop restores the color. If the work has been done carefully this should require but a single drop. This faint pink color, obtained with a single drop of the indicator, marks what is called the *endpoint*. It is the exact neutral point for the acid and base.

In like manner determine the endpoint, using litmus and methyl orange as indicators.

Standard Solutions: The work so far has been entirely *qualitative* and to make it *quantitative* solutions of a definite known strength must be made. These solutions are known as *normal*, *half-normal*, *tenth-normal*, etc., according to their strength. A normal solution of hydrochloric acid is one which contains in a liter of solution 1 gram of replaceable hydrogen ions. Thus for hydrochloric acid, which has a molecular weight of 36.45 a normal solution would contain that number of grams of hydrochloric acid gas per liter. A normal solution of any base must contain 17 grams of (OH) ions per liter of solution.

Preparation of a Half-Normal Hydrochloric Acid Solution: This will be the best concentration for the work that will follow, and is exactly half the strength of a normal solution. Hydrochloric acid, as you use it, is the gas dissolved in water, and we must use enough of the solution to get a half gram of hydrogen to a liter of the standard solution. Since 36.45 grams of the acid gas contains 1 gram of hydrogen, we shall have to measure out enough of the acid to give us 18.225 g. of the gas.

The large bottles of hydrochloric acid give on the label the percentage of HCl gas in the solution, and the density of the solution. In the concentrated acid the percentage is about 38 per cent. and the density about 1.4. This information you will have to obtain from your own bottle or from the druggist who sold the acid to you. Assuming that the foregoing figures are correct, to obtain the weight of hydrochloric acid solution that will be required, divide 18.225 by 0.38, being careful to get your decimal point correctly placed. The result will be the number of grams needed.

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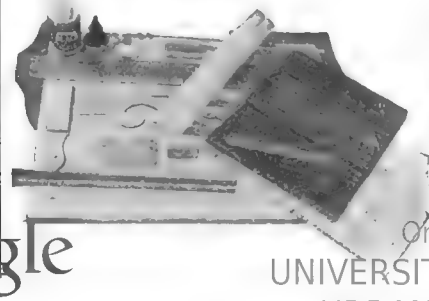

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but since the weight of 1 cc. of this solution is 1.4 grams, the number of cubic centimeters that you will need to measure out will be obtained by dividing the foregoing result by 1.4.

In order to get an exact liter of solution, a liter measuring flask having a ring etched on the neck will be required. The best way to get the exact volume of hydrochloric acid as per the foregoing calculation is to measure the acid from a burette directly into the liter flask, taking the readings with great exactness. Then fill the flask with distilled water at laboratory temperature, or 20 degrees Centigrade, just to mark etched on the neck.

Preparation of a Half-Normal Sodium Hydroxid Solution: Sodium hydroxid has a molecular weight of 40 and only one (OH) ion in its formula. Therefore we shall need for a half-normal solution 20 grams of the solid compound.

Weigh with the utmost accuracy of the balance at your command a clean watch glass. Weigh out upon this, as rapidly as possible, exactly 20 grams of the dry solid. Since the sodium hydroxid absorbs moisture, if this weighing is prolonged, it will not be very accurate. If you have a balance enclosed in a glass case, keep a small beaker of concentrated sulfuric acid sitting in it, and during the weighings keep the door closed as much as possible.

This sodium hydroxid should be placed in another liter measuring flask, and dissolved in distilled water, bringing the solution just to the mark on the neck.

Comparing the Two Solutions: Since each of the prepared solutions is exactly half-normal a cubic centimeter of one should just exactly neutralize a cubic centimeter of the other. We shall now proceed to try this out.

The first requisite for accurate titration after the solutions have been made is chemically clean burettes, that is, burettes from which every bit of dirt and grease have been removed, so that the solution will run freely and evenly down the sides, without leaving drops and irregular patches of liquid. To clean the burettes prepare a cleaning solution by dissolving 25 grams of chromic acid or potassium dichromate in 200 cc. of concentrated sulfuric acid. Warm this solution gently and from a small beaker fill each of the burettes. Allow the solution to stand for a few minutes and then open the stopcocks and let it all run into a beaker. Rinse the burette out and note whether the water runs down the sides without leaving drops. If not repeat the process until it will. Finally rinse with distilled water.

Now rinse one of the burettes with some of the standard hydrochloric acid solution, and then fill it just above the zero mark with the same. Open the stopcock and allow the solution to run a moment to fill the lower portion of the burette. In like manner fill the sodium hydroxid burette.

The next step is to take the initial reading of each burette. It will be noted that the surface of the liquid in the burette is in the form of a curve, concave downward. This curved surface is called the *meniscus* and the reading of the burette is taken at the lowest point of it. To get this reading accurately wrap around the burette a piece of colored paper having straight smooth edges and turn the colored side in. Hold the straight edges firmly together and place it two small divisions of the scale below the meniscus. Move the eye so that the back edge of the paper is just hidden by that in front, and observe the lowest position of the meniscus. This can be readily estimated to tenths of the small divisions which will be to hundredths of a cubic centimeter.

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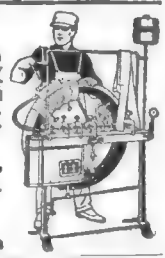

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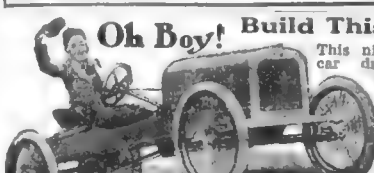

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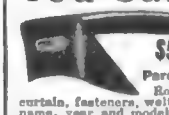

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half-normal hydrochloric acid solution. Rinse the beaker and stirring rod as before, add a drop or two of phenolphthalein, and titrate with the sodium hydroxid until the pink color appears. Passing back and forth from one burette to the other determine the endpoint, stopping when a single drop of the base produces a permanent pink.

Then read each burette again and in each case subtract the first reading from the second. If the standardization of the solution has been carefully done, you will find that the same number of cubic centimeters of solution has been used in each case.

Determination of the Purity of Baking Soda: Now that the preliminary work is out of the way some real analysis may begin.

Since baking soda will always contain moisture it will be necessary to dry it placed on a watch glass over a very low flame, in a drying oven. If a very high temperature is employed in drying, the soda will decompose and change in composition. When dry place the watch glass in a desiccator to cool. See Fig. 3.

Now weigh out exactly a half gram of the baking soda and place it in a small beaker. Dissolve the soda in a little cold water, being careful not to lose any of it by spattering. Add two drops of methyl orange indicator and titrate with the half-normal hydrochloric acid until the yellow color disappears and a pink is seen. Come back now with the half-normal base until the yellow reappears. Replace the beaker under the acid burette and titrate until a single drop will give the pink color. That will be the *endpoint*.

Subtract the initial readings of the burettes from the final readings and since 1 cc. of base is exactly equivalent to 1 cc. of acid, the difference between the volume of acid used and the smaller volume of base will give the number of cubic centimeters of acid required to neutralize the half gram of baking soda.

One cubic centimeter of half-normal hydrochloric acid will exactly neutralize 0.042 gram of pure sodium bicarbonate (baking soda). Calculate from the number of cubic centimeters of acid used the weight of sodium bicarbonate present in the half gram of soda taken, and then the percentage of purity.

Another way to get at this is to calculate the number of cubic centimeters that would be required if the sample were pure and compare this number with the number actually used.

Determination of the Purity of Cream of Tartar: Dry a small quantity of cream of tartar in the same manner as the baking soda was dried, cool in a desiccator, and weigh out exactly 1 gram into a clean beaker. Dissolve this in a little water, add a drop or two of phenolphthalein, and titrate with the standard sodium hydroxid until the permanent pink appears. Destroy this with the standard acid and then come back with the base until a single drop of it will give the pink. This will be the endpoint unless it should disappear upon standing a minute or two. If so add one drop more of the base.

From the initial and final readings of the burettes calculate the number of cubic centimeters of each solution used. Subtract from the volume of sodium hydroxide used the number of cubic centimeters of acid. One cubic centimeter of half-normal sodium hydroxide solution will exactly neutralize 0.094 g. of cream of tartar. Knowing this fact calculate the weight of cream of tartar in the gram of sample taken and from that the percentage of purity.

In this manner the purity of any acid or basic substance may be determined. In the next issue we shall take up additional determinations of this character.

(*Series to be continued.*)

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What Is a Hail-stone?

(*Continued from page 502*)

solid and gathers coatings of snow and frost. After a time, says Dr. Humphreys, in his latest meteorological work entitled, "Physics of the Air," each incipient hailstone gets into a weaker updraft, which is always irregular and puffy, or else it tumbles to the edge of the ascending column of air. In either case the hailstone then falls back into the region of liquid drops, where it gathers a layer of water, a portion of which is at once frozen by the inherent low temperature of the kernel. But again it meets an upward gust of air, or falls back where the ascending draft is stronger, and again the cyclic journey from realm of rain to region of snow is begun; and each time—there may be several—a new layer of ice and a fresh layer of snow are added.

In general, as Dr. Humphreys points out, the size of the hailstones will be roughly proportional to the strength of the convection current, but since their weights vary approximately (they are not homogeneous) as the cubes of their diameters; while the supporting force of the upward air current varies—also approximately, as only the square of the diameters—it follows that a limiting size is quickly reached. It is also evident, from the fact that a strong convection current is essential to the formation of hail, that it can occur only where this convection exists; that is, in the front portion of a heavy to violent thunderstorm. In other words, hailstones usually fall just before the rain in a thunder-storm or shortly after it starts to rain.

The older theory of the formation of hail which meteorologists have entertained is that the *roll scud*, see Fig. 2, formed between the ascending warm and descending cold air, is the seat of hail formation, but this is a mistaken assumption, states Dr. Humphreys. Centrifugal force would throw a solid object, like a hailstone, out of this roll probably before a single turn had been completed, he says. Besides, and this objection is, perhaps, more obviously fatal than the one just given, the temperature of the roll scud, because of its position, the lowest of the whole thunderstorm cloud, clearly must be many degrees above the freezing point. Indeed, as the above calculation shows, temperatures low enough for the formation of hail cannot often obtain at levels much less than three times that of the scud; and therefore, it evidently is in the higher levels of the cumulus cloud and not in the low scud, that hail must have its genesis and make its growth.

So here we have two variations of a single theory, which seems very plausible, and in an interview with Dr. Scarr, head of the New York City office of the U. S. Weather Bureau, this theory and outline of the formation of hailstones was upheld. Dr. Scarr, who is an expert on the physics of the atmosphere, agrees with Dr. Humphreys (the eminent author of the book aforementioned, and who is also Professor of Meteorological Physics, at the U. S. Weather Bureau, at Washington, D. C.), that hailstones are not formed instantaneously or otherwise, due to any electrical action. Some students of atmospheric physics have advanced theories that hailstones might be formed by the terrific electrical discharges occurring in thunderclouds, particularly as pointed out in an editorial on hailstones by Mr. H. Gernsback in the September, 1919, issue of this journal; and there is some justification for a theory constructed along electrical lines as to the formation of hail, for as Dr. Humphreys mentions in describing rain and sleet:

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"Water drops commonly do not unite on collision, but rebound, as shown by the scattering of a jet. This difficulty is met by the fact, however, that when slightly electrified, drops do unite on collision, as pointed out by Lord Rayleigh, together with the further fact that rain is always more or less electrified."

It is conceivable, therefore, that the electrical theory might work out in several different ways. Imagine, for example, that a very high charge of electricity is created in a certain region in a cloud by a lightning discharge; then why may not drops of water here and there be caused to combine with the other drops, and form into a hailstone by a sort of rolling process as they fall or are hurled thru suitably cold regions at high velocity. One thing seems certain, after studying the subject carefully and that is, to form hailstones we must first have a sufficient degree of cold or low temperature, unless there is some other action that takes place in the upper atmosphere, of which meteorologists are not aware.

Diagram 3 shows how a drop of water can be carried upward by the ascending draft of air which occurs in the fore part of a thunder storm as Fig. 2 shows, and how this nucleus or frozen drop of water will gather successive layers of snow—ice and clear ice, by its repeated journeys downward and upward until it becomes so large that it is ejected or thrown out from the upward rising air current and falls earthward with ever increasing velocity. It is interesting to note that while the hailstone or stones are forming, they will not drop just where they are formed but at a considerable distance further on, as the storm is moving rapidly along. It is not popularly known perhaps, that actual measurements have shown us how thunderstorms travel faster by night than by day and faster over the ocean than over land. The actual velocity of a thunder-storm varies considerably but its average speed in Europe is 18 to 30 miles per hour; while in the United States it is approximately 30 to 40 miles per hour. Hailstones, or at least the larger varieties of them, are fairly infrequent and people who have lived in the vicinity of Suffern their whole lifetime do not remember of ever having seen hailstones larger than a hickory nut, except once, about 23 years previously, at the time a cyclonic thunder-storm past along the Ramapo and Hackensack Valleys and tore houses from their foundation and practically annihilated every building in the town of Cherry Hill, near Hackensack, and which storm Mr. Secor, of our editorial staff, witnest personally. He also does not ever remember of seeing hailstones measuring 3″ to 3½″ in diameter, except at that time.

From the foregoing theory of hailstone formation, it is seen that a thunder-storm may produce hail along a certain part of its journey, the hail then ceasing for another part of its duration, etc. Such was the case with the storm which took place on July 31st, and it was very surprising indeed, as an automobile trip after the storm disclosed, that the path of destruction created by the fall of large hailstones was very narrow or about one-half mile. People residing in towns just a few miles beyond where the storm was so severe, only experienced a fall of ordinary hail, about the size of a pea or a little larger, and could hardly believe that such large hailstones had actually fallen at the points mentioned, but photographs and actual measurements prove it.

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Revealing Your True Vocation

By Dr. M. P. VON DAVID, M.D.

(Continued from page 514)

Another point to introduce here is this: There is no chemical reaction which is not accompanied by an electrical disturbance. However slight the reaction may be, an electrical disturbance is present. Decomposition of radioactive substances and brain cells alike produce electrical disturbances. In the realm of ultra-physics, matter and electricity have receded to the same cavern of cosmic mystery—the primordial electron. When the electron travels in a straight line, (as along a wire) an electric current is produced. If the electron, along with other electrons, revolves in orbits, to form a miniature solar system, the result is an atom of matter.

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Let us review briefly at this point, the development of our idea: We first had some evidence which suggested thought to be a form of radiant energy. Radiant energy is the resultant of decomposition, elemental or compound. We know that decomposition of brain cells occurs in concentrated thought, and indeed, quite as surely tho less intensely in any thought process; and there is no evidence against assuming that subconscious thought is quite as complete a process of decomposition as focal thought in consciousness. In fact this is not an assumption at all; for, should we be required to think of every muscle and bone which moved before we took a step, our pedal progress would be nil. Those functions certainly require a subconscious expenditure of thought, and this much alone is sufficient to indicate that radiant energy is subconsciously expended by the brain in the most involuntary movements. Our next step was associating decomposition with electrical disturbances, which is a universal chemical attribute. We could not hope to effectively employ the actual body currents directly, but we might expect to use them indirectly, and interpret the effects which they would induce.

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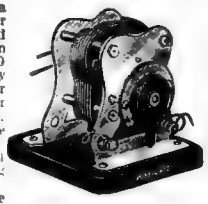

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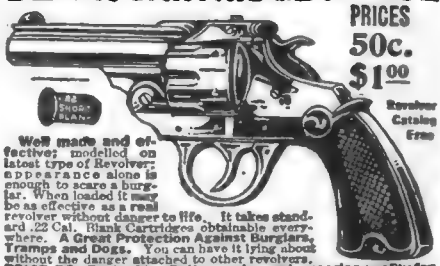

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third room is a compensating apparatus which establishes an equilibrium between the subject's body resistance and a small current supplied by a set of batteries.

The subject places the index and middle fingers of both hands into each of the two small cups of mercury on the table in the first room. The salt solution insures a perfect contact between the subject's fingers and the circuit which is broken between the cups. A few moments are spent by a trained expert on the compensating device, to establish a perfect equilibrium. The subject fixes his attention on the blank wall in front of him. Suddenly a vocational word is flashed upon the screen before him, then another, and another. A list of over a hundred well-known vocations are introduced to the subject's mind, in easy succession. He is given ample time to fix his entire attention upon the word, and to absorb the meaning of the kind of work the word suggests. To watch a subject viewing this list, would give small hint indeed of what was going on in his mind. Slight facial expressions might be noticed, and certain words might demand more of his attention than others. But the real analysis is occurring in the other rooms, on the recording galvanometer.

Without the subject's knowledge, he is affecting the resistance of his body by his thoughts; and as these effects are positive or negative toward a given vocation, they are faithfully recorded on the moving tape of the galvanometer. Activities which he may presume, or pretend to like, by reason of parental or other coaxing will not affect the readings; his real capacity for a given vocation is registered without error by the oscillograph. It is almost uncanny to see those subconscious revelations of relative adaptation for various forms of life work. And every emotion, even subconscious, is registered by its own peculiar curve from the stylus or light beam from the galvanometer.

The subject is alone; his thoughts are spontaneous and uninfluenced by others. He is speaking, subconsciously, as himself and not as parental fondness describes him to the visiting relatives. The freedom of mind-action avoids introducing errors that a verbal examination would induce; for a child would tend to answer as its parent would have him answer, and there is often a difference. The interpretation of the tape requires an expert knowledge of "norms," and would entail description of technique out of place in this article.

Our cover illustration shows a modified system for revealing your true vocation. Instead of using three separate rooms, the subject, and also the operator, are placed in the same room together.

The subject sits in front of the blank wall against which are projected the various vocations such as Doctor, Lawyer, Chemist, Artist, Farmer, etc. The subject's fingers are immersed into the two cups containing liquid mercury and a saline solution; the two cups are then connected with an ordinary Einthoven galvanometer, which registers the electric current produced physiologically by the subject himself. The greater his interest—in other words, emotion—the stronger his heart will pump. This in turn gives rise to a larger current which in turn is recorded by the sensitive galvanometer. The beam of light from the galvanometer plays upon a scale which is hidden from the subject. In other words, he has no means of watching the scale itself, which might distract his attention. His whole attention is centered upon the names of the professions which he reads on the wall. The largest deflection on the scale, carefully noted by the observer, is written down by him and this deflection, as a rule, will show the true vocation of the subject.

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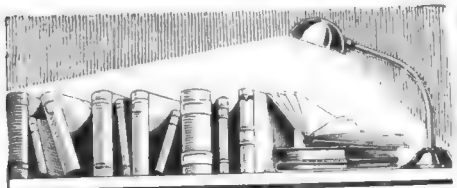

BOOK REVIEW

A TEXT BOOK OF ORGANIC CHEMISTRY. By E. De Barry Barnett. Cloth covers, size 5½" by 8½", 380 pages. Fifteen illustrations. Publisht by P. Blakiston's Son & Co., Philadelphia, Pa.

We cannot too strongly recommend Dr. Barnett's book to our readers. Sometimes the English text books, written to meet the requirements of some of the examinations of the London University and the like, are subject to criticism as often stopping far short of the desired point which they should reach; but this little book is free from that defect. It is divided into chapters, and while its treatment of the subject is really quite full, references to titles of other books in the literature of the subjects are given in a number of instances at the ends of these pages.

As an excellent example of treatment, we would refer to Chapter One, Part Two, on aromatic compounds. In its 11 pages, the nomenclature of the subject, orientation, grouping and other topics are all lucidly explained, and this chapter ends like many of the others,—with reference to other books.

The index is quite adequate and the only possible criticism that we can make is, that we would have liked the book to have been a little more explicit in its definitions.

We have noticed a few minor errors which should be corrected in future editions. On page 42 the formula for sodium acetate is inadvertently given as acetic acid. On the next page paraffin is incorrectly derived, as *affinis* is an adjective and not a noun, and *parum* is hardly to be rendered as *no*. He also is in error in stating that the names of the higher paraffins are derived "from the *Latin* numeral for the number of carbon atoms." They are derived from the Greek numerals.

ELEMENTARY ENGINEERING. By Ralph Preston Clarkson. Profusely illustrated. Cloth covers, size 5½" by 7½", 187 pages. Publisht by the D. Van Nostrand Co., New York.

This valuable little manual gives the bases of electrical engineering with numerous illustrations and with a sufficient use of mathematics to give the book true scientific value; a certain number of questions and problems for answering and for solution by the student are also given in the work. A number of tables make it of permanent value and on the whole it is a book which we are inclined to recommend highly to our readers.

It is short and compact and if anybody will go thru it as it should be read, and do the problems and answer the questions, he will certainly learn a good deal.

THE COMPLETE AIRMAN. By G. C. Bailey, D.S.C., R.A.F. With numerous illustrations. Cloth covers, size 5½" by 8½", 269 pages. Publisht by the E. P. Dutton Co., New York.

We have before us in Dr. G. C. Bailey's exhaustive treatise a contribution of importance, a book devoted to the subject of airplanes. The theory of flight, general mechanisms, the construction and materials used in airplanes, the camber and other features of the wings, the control system, fuselage and details of the engine are given with full illustrations.

Other details of the airman's profession are included, and for those who are interested in aviation, as who is not, the book will make really interesting reading, as it is devoid of too great a development of the purely technical side. It is very fully illustrated and has a good index.

BRITAIN'S HERITAGE OF SCIENCE. By Arthur Schuster, F.R.S., and Arthur E. Shipley, F.R.S. Fully illustrated. Cloth covers, size 5" by 7¾", 334 pages. Publisht by the E. P. Dutton Co., New York.

Why a heritage of science should not be a world's heritage but should be restricted to a nation is far from clear to the writer of this review. But when we state that in this work the discoveries of the many English scientists for the most part are the only subjects treated, the initial bearing of the book becomes clear. It is excellent reading, not at all too technical, and there is so much personal interest in the text, which really is in a sense a series of biographical notes, that it is as good or better reading than many of the best sellers.

A very interesting feature is the collection of portraits. These are fifteen in number,—from Sir Isaac Newton down to Lord Kelvin, Darwin, and Lyle. The book receives our fullest commendation. Its index is particularly commended for its completeness.

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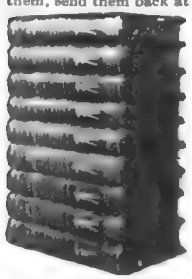

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Sawing Thru Houses and Streets

(*Continued from page 503*)

For this work a cable over 300 feet in length was required. Here the second lay of the cable had to follow the first right down thru the cut, and after twenty hours of work, it was found necessary to replace the cable. Some five inches an hour measured the speed of the cutting. Sometimes it was much less than this, according to the material it encountered. In one case it was necessary to make a short horizontal cut and this was quite successfully done, it taking, however, an hour to do 2 inches for both lays of the wire. The work of cutting down between these two buildings was considerably more complicated than the work done on the bridge.

The method is not new. It goes back to the year 1854, the first suggestion being attributed to a French inventor. It will be realized that the helical marks in the cable, determined by its structure, operate to hold the abrasive and make the cable do better work.

It is considered that the fact of the upper or idle lead of the cable having to pass thru the cut, following the working lead as described, operated to wear out the cable much quicker than when only one lead entered the cut.

Flint in the concrete and the lack of homogeniety made the cutting excessively slow, less than the normal progress for an hour, requiring over eleven hours for completing.

The operation was most successful in the bridge work and in sawing down thru the high party-wall of the two buildings. It is most suggestive of utility in many delicate engineering operations.

The cable was strained by counterweights at one end, and these are of a weight to exert the desired tension on it. In one case the counterweights weighed nearly 450 pounds, certainly a very moderate amount. The breaking of the cable is always a possibility, so the counterweights have at a short distance below them bags of sand to deaden the shock if they should fall.

The driving pulley made 180 revolutions a minute, giving the cable a linear speed of about 20 feet a second.

Preparing Objects for the Microscope

By EARLE R. CALEY

(*Continued from page 532*)

the supernatant liquid which contain the diatoms, poured off, leaving the sand behind. This is an exceptional elaboration of the cleaning process. In mounting diatoms a drop of distilled water containing them is taken up with a pipette and placed upon a cover glass (never upon the slide) and the cover glass placed upon a piece of tin and heated to low red heat. This destroys the organic matter and leaves the diatoms adhering to the cover as pure white skeletons. The cover is then attached to a shallow cell in the manner already described. In mounting starches the starch is taken up with water, forming a thin, opalescent liquid. A drop of this liquid is then placed on the cover, and the whole left in a desiccator until thoroly dry. Then the process is continued as above. In case dark-ground illumination is desired the bottom of a varnish cell should be coated with flat black and the object mounted therein.

(To be Concluded.)

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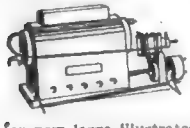

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Renewing Your Blood

By H. W. SECOR and J. H. KRAUS

(*Continued from page* 507)

cured to the subject's body. After two experiments carried out in the laboratory of Long Island College Hospital, by Professor Kretz, instructor in Physiology and Physiological Chemistry, and by Mr. Kraus, Prof. Kretz being greatly interested in the experiment, in which the animals used for this research work succumbed, it was finally decided that the best method of carrying out the blood purification process here suggested, would be to connect the purifying apparatus with the patient, as shown in the illustration, so that the blood would be taken from a vein in one arm, passed thru the apparatus, and finally allowed to pass back into a vein in the patient's other arm. In this way only a small portion of the blood, possibly 5 per cent of the total volume (the average human body contains approximately 35 quarts of blood), would be passing thru the purification apparatus at any given time. Following this method the blood would have to be past thru the apparatus for a considerable time, possibly 20 to 30 minutes, so that eventually all of the patient's blood would pass thru it, and then the relative condition could be checked from time to time, by taking small samples from the apparatus and applying the usual microscopic and other tests.

The main reason why this latter method has been decided upon as the proper one to be used in this purification process, when it has been worked out in more detail and actually applied in our hospitals, is based on the fact that in the former method just exactly what the authors predicted actually happened. That is, the animal in each experiment ceased breathing when about 90 per cent of the blood had been extracted. It is interesting undoubtedly for the layman to bear in mind that the blood has the peculiar property of clotting, coagulating or thickening, and in order to prevent this, it had to be kept moving in a warm chamber, free from air, and also a certain amount of saline or Locke's solution added to it. It is a remarkable thing to note that the heart kept on beating very strongly, and in fact was still pulsating three hours after the operation was started. (An animal's heart has been kept beating for eight days after its removal from the body, by placing it in nutrient saline solution.) Artificial respiration as well as the use of a pulmotor were brought into play in an effort to keep the animal fully alive (of course the animal in each experiment was anesthetized before starting to extract the blood), but as the lungs had no reason for functioning, respiration ceased under the conditions brought about. No solution equivalent to the blood has ever been developed; in blood the red corpuscles carry the oxygen, and this property is not present in saline or other similar solutions used in such work. Part of this original idea was based upon the interesting fact that in major surgical operations, where the patient may have lost a large amount of blood, the loss is sometimes compensated for by pumping saline solution into the blood stream, and this is left in the body, the natural physiological processes taking care of it.

One of the admirable advantages of the newer scheme here illustrated, where only a part of the blood is purified at a time, lies in the fact that the patient does not necessarily have to be anesthetized. In other words, the patient can be fully conscious as the only surgery involved is to make slight incisions, with the aid of a local anesthetic, and to place the two hollow

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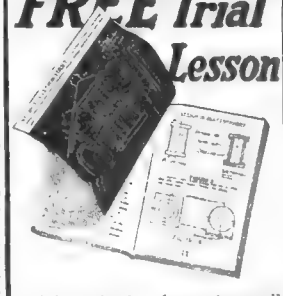

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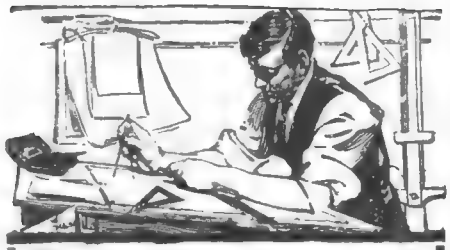

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silver needles in the median basilic veins of either arm. A special glass pump is used to force the blood thru the first rubber tube into and thru the first stages of the purifying process; this pump is placed near the end of the chain of apparatus, which by its alternate suction and pressure will help to draw the blood thru the apparatus and force it back into the body.

DETAILS OF THE BLOOD PURIFYING APPARATUS

The theoretical apparatus used for purifying the blood involves both chemical and electrical actions in the present arrangement; but of course later developments will undoubtedly be worked out, which may simplify the method involved to a very considerable extent.

When the blood under its original pressure enters the first compartment, which is kept warm to the proper degree by an electric heating coil (controlled by a rheostat, and the heat being observed by the thermometer shown in each instrument), Neosalvarsan or arsphenamine and Locke's solution are injected into the blood, passing thru the instrument, by adjusting the dropping device on their containers at the top, so that any desired percentage of these solutions can be injected into the blood. The Locke's or saline solution helps to prevent the blood from coagulating, as does also the warmth created by the electric heating coil, while the neosalvarsan annihilates any syphilis germs which may be present. The comparative purity of the blood from this disease is checked up in the usual way by taking a small sample now and then. The microscope will show the presence of large quantities of such germs, while a culture will have to be made to make a final test for small numbers of these germs, which requires some time. If the culture indicates the presence of such germs, the patient may need to have the blood purified once more at a later date. Other disease germs can be destroyed by treating the blood with the proper serums or medicines.

When the blood stream reaches the second instrument, we have another chance to add any disease germ destroyer or hyperacidity corrective, such as methylene blue for destroying gonococci, which may be in the blood and typhoid serum for typhoid. In the third stage of the purification apparatus, the blood passes back and forth thru a glass tube grid and as it does so, it is subjected to powerful ultra-violet rays, which, as is well known, act to kill practically all forms of disease germs. There are several different arrangements which can be used, particularly owing to the fact that the dosage of ultra-violet rays (here produced by mercury vapor lamps, fitted with quartz tubes), cannot be made very strong, as these and X-rays have an untoward effect on the corpuscles of the blood, the ultra-violet on the white corpuscles, and the X-rays on the red cells, as recently discovered by two French scientists. So if finally found desirable, after further research work in this direction, the ultra-violet ray purifying stage may be eliminated and all the purifying done chemically, by an arrangement such as already provided for in the first and second stages of the apparatus here suggested by the authors, or by a modified apparatus.

And as for the removal of urea, this could undoubtedly be removed from the blood by allowing it to pass into a chamber divided by an animal membrane, the blood passing on one side and a solution of higher specific gravity than the blood on the other side. Then due to an osmotic action the urea will pass thru the membrane without changing the other constituents or interfering with the progress.

It is confidently believed by the authors that this method, once perfected and adopted, will mark a new epoch in the wonderful science of blood treatment.

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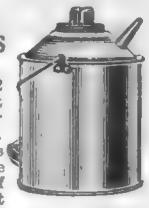

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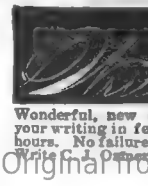

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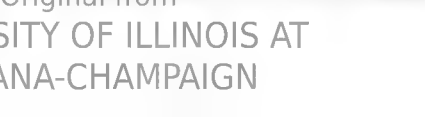

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How to Build a 1/16 H. P., A. C. Motor

By H. JOHNSTONE

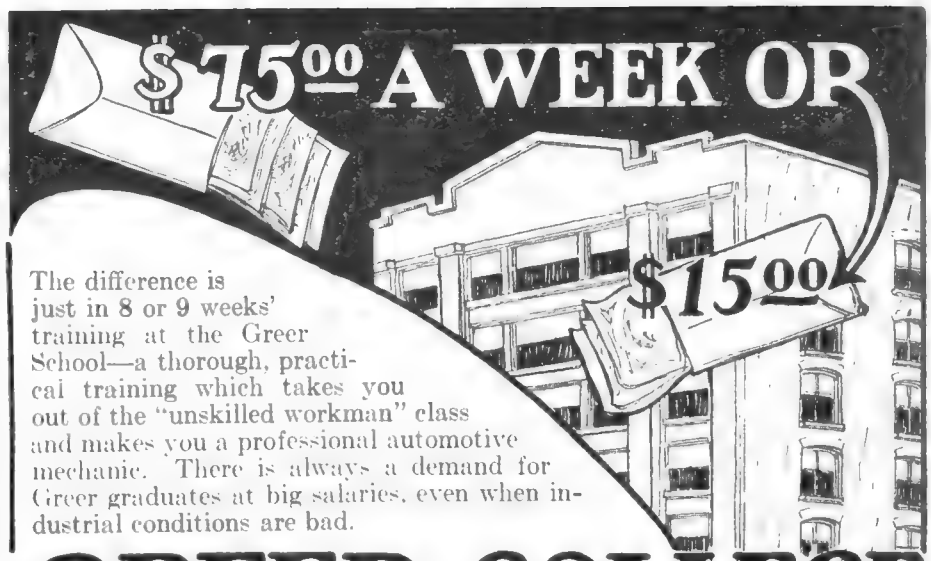
(*Continued from page* 531)

form, such as shown at Fig. 1-C, is constructed for winding the stator coils. The coils measure about 9/16″ in width by 3/8″ in depth. The other dimensions are given in the drawing. Flexible lead wires should be soldered to the magnet wire and tied in position with a string, before the coils are taped. Ordinary cotton tape about 5/8″ wide is used and lapt about one-half its width. The coils are taped before bending, the amount of curvature being very slight. A piece of oiled linen or Empire cloth should be cut to fit around the iron stator pole before the coil is placed in position, and this should be cut large enough so as to insulate between the yoke and the coil as at X, Fig. 1-A, to prevent grounds and short-circuits between the iron frame and the windings. The oiled linen insulation around the pole should be arranged to cover and extend over the top of the coil also, under the copper starting plate, so that this will not bear directly upon the tape covering the coil. The dimensions of the four-copper shading plates are given at Fig. 1-D. These plates may be a little thinner or thicker than the dimensions given, without reducing the efficiency of the motor to any noticeable extent. The direction of the rotor when revolving, is shown by the arrow; it is right-handed or clockwise with the four shading plates in the position on the stator poles here illustrated. To reverse the direction of rotation of the rotor in this type of A. C. motor, it is necessary to reverse the position of the copper shading plates. That is, the four plates will have to be placed on the opposite corners of the four stator poles.

The four stator coils are connected in series, and the direction of current thru them is checked, if necessary, by connecting to a source of direct current, either thru a 100-watt lamp on 110 volt D. C., or else to a source of battery current having a potential of 10 to 12 volts, and the polarity checked by means of a small pocket compass held near each pole so that they alternate as shown—south, north, south, north. Each successive pole should attract opposite ends of the compass needle. If this form of test is not used, then by remembering which way the coils and leads are arranged, the direction of the current passing around the successive poles can readily be traced, and the current should reverse its direction around each successive pole.

The bearing supports may be designed in several different ways and by studying the construction and form of some of the small commercial motors upon the market, some practical ideas in this direction will easily be gleaned. In any event the bearings should certainly be fitted with wick oil cups, which can be purchased from any electrical repair shop selling fan motor supplies, etc.

This motor will be found useful for driving fans, either 10″ or 12″ diameter of blades, or for driving rotary spark gaps in radio sets, and other light machinery. When the current is switched on to the stator coil terminals, the motor is self-starting and it soon reaches its speed of 1750 revolutions per minute. The synchronous speed of this motor is 1,800 R. P. M., but there is always some slip; so if we allow 3% for this factor, then the net speed with load, figures out to 1,746 or practically 1,750 R. P. M. The speed of an induction motor in R. P. M. is found by multiplying 2 ti...es the frequency in cycles per second by 60, and dividing the product by the number of stator poles.



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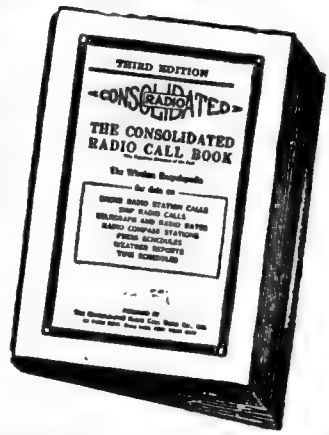

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Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Dirigible Auto Head Lights

(488) Roy H. Williams, Brainerd, Minn., enters an idea of a dirigible headlight attachment for cars.

A. Automobile lights such as you have described are the subject of a recent patent, and we do not see how it is possible for you to obtain a patent on your device without infringing upon the one which is mentioned.

The device as described, consists of rods and levers and may be applied to any form of car. In view of this we do not believe you could even obtain a patent.

Combination Fan and Heater

(489) J. J. Witkowski, Albion, N. Y., submits a drawing of an electric fan upon the blades of which are mounted special heaters. He requests our advice.

A. The idea which you have devised is indeed very clever, but there are several drawbacks to it.

We would state that there is a heater upon the market at the present time which heats a grid. This grid is put in front of an electric fan and so placed that it may be thrown in or out of the circuit as desired. The fan can then be used and by simply turning the switch again, the grid will heat up and hot air will be circulated thruout the room. The grid current may be turned off again at will.

The idea of placing a heater upon the blades of a fan is slightly different and tho it contains considerable merit, it would be far less efficient to use this form than the form mentioned above.

You are quite right in assuming that a large area may be heated or, rather, speaking in technical terms, the heated air is distributed better than in those heaters which employ no air current.

We would advise that you investigate this idea and if possible build a working model of the same and determine just how much more efficient it is than the grid form of heater, by actual measurement of the temperature in a given room, using first one form of heater and then the other.

Some More Perpetual Motion

(490) Raymond Leatherman, Chicago, Ill., submits a sketch of a device in which water is pumped to a tank by a motor, this passes downwards thru a water motor, which operates a generator; the generator supplies current for the motor-driven pump.

A. The scheme will never work for the simple reaon that the efficiency of a motor is only about 80%. The efficiency of a water motor is again 80%, and the efficiency of a generator only about 82%. The efficiency of a pump is 90%.

Multiplying all these together, we get for the efficiency of the entire outfit, 47.2% and therefore, you will not even get one-half as much power from the apparatus as is put into it.

Ye Gods! Here It Is Again

(491) M. G. Levenson, Lawrence, Mass., says: There is naturally a large amount of pressure at the bottom of a ship. My idea is to drill a hole thru the bottom, connect this to a pipe arranged like a syphon and the water will flow up thru the bottom and over the side of a ship due to the pressure. A water turbine can be inserted for power.

A. Your idea of perpetual motion will never work because the water within a container such as a ship will never rise higher than the water surrounding the ship, even tho there is a tremendous pressure at the bottom.

Remember, that this pressure at the bottom is exerted in all directions, and that the instant the pipe is filled up, a pressure within the pipe of .437 pounds for each foot belo wthe zero line will be realized just the same as in the water

Luminous Tennis Ball

(492) Chas. Amis, Bluefield, W. Va., asks: "Do you think I could obtain a patent on a radium-paint covered tennis ball for night games?"

A. We do not believe that radium covered tennis balls would be of any value, for the simple reason that radium, unless impregnated with the rubber, would wear off after the ball had received three or four resounding smacks. In addition the tennis ball would lack the resiliency which it now has. Besides it would have to be pitch dark in order to see the ball a condition almost impossible of realizing in the open.

Self-Lighting Cigarettes

(493) E. H. Avey, Jr., Mesa, Arizona, submits a description of a cigarette which has a match composition head at one end and a striking surface on the package.

A. We will admit that your idea is very ingenious, but it does not work. Five or six years ago the editor attempted to make cigarettes with a match tip to them. There are many drawbacks to this form of cigarette.

In the first place it does not always light. Sometimes the cigarette breaks, but, worst of all, the match head substance on the end of the cigarette bursts up into a flare. One puff upon the cigarette at this time causes a sulfur taste to permeate the tobacco and enter the smoker's mouth. This sulfur taste remains as long as the cigarette is being smoked. For this reason we do not think your idea practical nor do we advise a patent on the same.

Radio on Trains

(494) C. P. Brady, Georgetown, Texas, writes: "I am not familiar with radio but would like your opinion as to the advisability of securing a patent for sending wireless messages to and from moving trains."

A. Radio on trains is practical and has been accomplished time and again. The only difficulty is the cost of installation. We would have to know more about your device before we can give further advice.

Extent of Wheel Patent Claims

(495) M. Benz, South Chicago, Ill., sends us a patent of a vehicle wheel issued to him and asks whether his patent is broad enough to cover two other ideas just evolved.

A. In our opinion the patent which you have obtained is broad enough to cover the sketches which you have forwarded us, and we believe that any litigation which may arise, could easily be cast out, when your patent is brought up for proof as to the points it covers.

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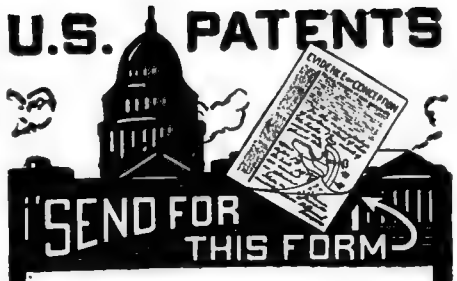

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Telegraph Speed Key

(496) E. W. Bierre, Wellington, New Zealand, enters a good description of a telegraph key and system, the contact points of which key are attached to levers connecting with the rest of the key. He claims extra speed for this system.

A. We do not consider your idea of the telegraph key patentable or even practicable for the following reasons:

First, it has been definitely ascertained that over considerable lengths of telegraph lines, there is a great lag—the signals not coming in clearly. This is particularly noticeable in trans-oceanic telegraphy, where the keys in question operate very high speed, rapidly-acting transmitting relays. We do not believe that you could compare your system with these relays for efficiency—yet in spite of that it has been found that the signals on the receiving end are not clear and distinct, altho if a galvanometer is placed in the circuit its fluctuations are distinct.

Recent patents have been taken out which employ these relays, and light focused on to the mirror of a galvanometer at the receiving end acts upon light sensitive cells, which in turn operate the receiver and the stylus-pens.

Another feature, which would not permit us to look upon your key in a favorable light, is the lever system, which is subject to wear and also to a retarding of the motion, in view of the numerous fulcrums and levers present.

Air Spring Motor

(497) A. W. Clinton, Amsterdam, N. Y., submits a sketch and a rather vague description of an air spring motor and an automatic typewriter. In the air spring motor a column of air, in the words of the inventor, is "fired."

A. We do not believe that either of your two ideas will be of very great value. In the first place, the automatic typewriter is entirely too elaborate and much less efficient than several automatic typewriters now on the market.

Your device entails too many adjustments and there are too many parts, and therefore, it would never work continuously. In addition, the method of regulating the same is inadequate for its purpose.

In reference to your air spring motor, we do not see how you could possibly have any "firing" of a comprest column of air and hence cannot see wherein it would work.

Perpetual Motion Bicycle

(498) Amos. W. Bradley, Jonesboro, Ark., sends us a sketch of a perpetual motion bicycle and asks a few questions on patent attorneys.

A. Obviously, your idea brings up the old discussion on perpetual motion machines, when you claim that a motor could be made for bicycles, which, after starting, will continue to run indefinitely.

This is impossible. Surely your motor could not cost so much to produce, as to prevent you from building a model. The building of a model will convince you that our statement is correct.

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Automatic Railroad Gate

(499) A. C. Byerly, Ohl, Pa., submits a sketch of an automatic railroad gate which closes automatically when the train passes a block signal.

A. There is nothing radically new in your design or construction of an automatic gate and we believe that you will find it very difficult to secure a patent; in fact, we do not believe that you can possibly secure a patent on such a contrivance, it already having been fully exploited and patented.

What is wanted, is an automatic crossing gate which will absolutely prevent an automobile from making a crossing after the gate has once been locked.

The writer has been present on several occasions, where, in spite of all warnings, such as gongs, lights, etc., the speeding automobilist would plunge his machine thru the frail gates, smashing them to pieces. Further than that, a gate must be employed, which will allow any traffic between the gates to proceed to the other side, but yet prevent further traffic from making a crossing. When this is possible, then, and not until then, can watchmen be eliminated at the crossings.

Toy Elevator

(500) J. F. Carlson, Irwin, Pa., submits a sketch of a toy perpetual sand elevator which he admits is not a perpetual motion machine nor intended as such.

A. Bearing in mind that your device could not possibly be a perpetual sand elevator, and that it would not function for even ten minutes without requiring the sand to be hoisted up from the bottom and replaced in the funnel at the top, we would advise that we believe the contrivance patentable.

You must remember that the buckets will never carry as much sand up to the top as is used in propelling them, and the result is that before long the bottom of the elevator will fill up with sand, offering sufficient resistance to prevent the paddle wheel from turning the buckets.

A water elevator of this nature would be much better, but even water will pour out of the funnel so rapidly that but a very few buckets of water, if any, would be raised to the top.

As a toy, however, you could probably find a market for it, in which event we would advise a trap door at the bottom of the funnel, and a crank, so that when the device stops the funnel could be filled up again by simply turning the crank.

You will find companies advertising in this journal who can take over the work of building a model for you and apply for a patent.

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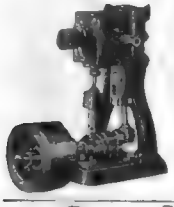

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Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

(*Continued from page 510*)

suspended animation, whose solution has been almost within our grasp. The problem really consists of four simple ones. 1. How to put the patient to sleep. 2. To find the best conditions of temperature, humidity and ventilation. 3. The best method of feeding the subject artificially, if the catalepsy is to be of prolonged duration. 4. The best method of awakening the individual at will.

"As you see, not one of these presents any special difficulties. As regards the first point, we may allow the patient to fall asleep in the normal manner, just as an animal does when it hibernates. The second problem is merely a question of experiment. The normal temperature of the body is what I have found to be the best, and just sufficient humidity to prevent the drying up of the tissues. By keeping my subjects in these hermetically sealed glass coffins, I have no difficulty in achieving these ends. As regards feeding the subject, this is only necessary in rare cases. With the living activities reduced to a minimum the patient can live for months on his own fat. As to awakening the individual when the experiment has been carried as far as I wish, I find no difficulty at all. For most practical purposes only a short trance is required."

"What do you mean by practical purposes?" asked the reporter in surprise. "You surely do not mean to say that you can turn this suspended animation to any practical use?"

"Indeed I do, Mr. Rockett. In fact this very day I am shipping off to Europe ten thousand thoroughbred cattle of the highest quality to replace those destroyed during the war."

"And you ship these cattle in a trance?"

"Say rather in a state of suspended animation. To transport ten thousand live cattle across the Atlantic is a difficult and expensive matter, but I simplify it considerably by putting the cattle to sleep for the term of the voyage. I first drive the cattle into a large room which I fill with carbon dioxide until the animals lose consciousness. Then I drive off the gas and my men load the unconscious beasts into air-tight chambers on the ship, which are also kept full of carbon dioxide during the whole term of the voyage. On the vessel's arrival in France, the animals are placed in pure oxygen and by the combined use of a pulmotor, electric currents, and heart massage we have no trouble in starting the action of the heart and bringing the beasts back to life again, not a whit the worse for their experience."

"I see," said Silas Rockett, nodding his head. "I begin to understand how your discovery can be very valuable in transporting live-stock. You can save space, labor, and food for the animals during the passage. But in what way could your suspended animation be of any practical utility in the case of human beings?"

"I have already found several uses for it," returned the doctor, "and new ones will continue to arise in the future. To begin with, there is the case of would-be suicides. I advertise in the papers offering to put them to sleep for a term of years. When they awake under the changed conditions they are pretty sure to have lost all desire to kill themselves.

"Then, too, I use the method for superfluous babies. I have already prevented several cases of infanticide. A young girl, whose life would be ruined by her baby

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comes to me and I put the infant to sleep until the mother is ready to take it again. So, too, with parents who have more children than they can support, and who would be driven to advertise one or more for adoption. I keep the child asleep until the parents are able to support it.

"But it is especially in the case of criminals that my invention proves of use."

"Criminals?"

"Yes. Our judges now need not condemn a man to prison for a term of years. They condemn him to sleep for that period. They thus save all the expenses of prisons, jailers, food, etc., and they avoid the contact in our jails, which makes a novice, who enters prison, come out a finished criminal."

"But the prisoner has no chance to reform."

"When he comes out from his long sleep, he will find conditions have changed. His old pals will not be there to tempt him, and he can begin life anew.

"As regards capital punishment, my invention will do away with it altogether. Instead of executing a man we will put him to sleep for fifty or a hundred years and trust that the new generation will know better how to deal with him."

"Gentleman to see you, doctor!" interrupted the office boy, coming in at this juncture.

Doctor Hackensaw glanced at the card tendered him: "Cyrus McAndrews, curator of the Knickerbocker University," he read. "I can't say I ever heard of the gentleman," he mused, "but show him in."

The door opened and a portly gentleman appeared.

"Glad to see you, Doctor Hackensaw," said he. "I've got a little job for you." And he chuckled gleefully, as if tickled by a good joke.

"Happy to meet you, Mr. McAndrews," said the doctor, extending his hand. "What is it I can do for you? You look as if you wanted the use of one of my coffins for three months as a winter resort."

"Ha! Ha! Ha!" laughed the curator gleefully. "Ah, doctor. I've heard of how you pickle patients who are sufferers from hay fever, grippe, pneumonia and other such diseases. Instead of making them travel for the season during which their disease is prevalent, you merely put them to sleep for a month or two and so save them considerable expense. By the bye, how does the scheme work?"

"Admirably," returned Doctor Hackensaw. "The patients not only pass thru the bad season without danger, but the sterilizing processes I make them undergo, not only check the action of their body microbes during the long sleep, but actually destroy many of the disease germs and so prove highly beneficial."

"Well," said Mr. McAndrews, "I haven't come to-day for a three-months trance. When I do come to you to be put to sleep it will be for a few hundred years. I will put a thousand dollars at interest in the savings bank first, and ask to be awakened only when this sum, at compound interest, amounts to a million.

"But, joking aside, doctor," continued the curator, "I have come to-day on an errand, stranger perhaps than any you have yet known. I suppose you have seen in the newspapers that I have just returned from an exploring expedition to the polar regions. I may say that I have been exceedingly successful and am bringing back with me scientific material of the highest value."

"Indeed?" said Doctor Hackensaw.

"Yes," said Mr. McAndrews, "but what

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I regard as far and away the most valuable result of my search is a specimen that I found completely embedded in the ice near the northern coast of Siberia. It is in such a perfect state of preservation that I am going to ask you to try to resuscitate it."

"Is the specimen still embedded in the cake of ice?" asked the doctor.

"Yes, indeed. Under no consideration would I have attempted to thaw it out. I have the creature in the Bronx now, still embedded in the original block of ice."

"And what kind of an animal is it?" inquired the doctor.

The curator hesitated an instant. "It is a *pterodactyl*," he said.

"A pterodactyl!" echoed the doctor. "You don't mean to say it is one of those flying reptiles with bony, leathery wings like a bat."

"Precisely, and my specimen is perfect to the very tips of its wings and claws."

"But, man alive!" exclaimed the doctor in excitement, "don't you know that the pterodactyl is an antediluvian monster, that has been extinct for hundreds of thousands of years."

"Certainly, but this specimen, caught in the ice, has been marvelously preserved and appears as fresh now as if still alive. And that is the reason why, hearing of your successes in cases of suspended animation, I decided to ask you to try to resuscitate this monster for me. If you can bring your apparatus up to my house to-morrow morning, that will give me time to have the creature thawed out slowly, so that it will be all ready for you——"

* * * * * * *

The following morning dawned bright and clear, and before ten o'clock Doctor Hackensaw, with Silas Rockett and Cyrus McAndrew, might have been seen in a vacant lot in the Bronx, busily engaged upon the task of resuscitating this primitive antediluvan monster,—half-bird, half-reptile,—that marked the dividing line between these two great classes of vertebrates.

The ungainly creature had been slowly thawed out of its block of ice and brought back to normal temperature, and it now lay stretched lifeless on the ground. It was a perfect specimen in every respect —not a single flaw could be detected anywhere.

Doctor Hackensaw scrutinized the animal with the greatest curiosity, and he shook his head as he gazed at the fierce crocodile-shaped jaws with their rows of sharp shining teeth.

"He looks like a tough customer, Mr. McAndrews," said he. "Have you got some good strong rope to tie him with?"

"Yes, my chauffeur has just gone to the house to get them. He'll be back in a minute, so we needn't wait. It will take some time to revive the creature."

Doctor Hackensaw was trembling with excitement. The experiment he was about to try was one which would mark an epoch in scientific annals. Yet he was strongly sanguine of success, for the creature appeared as fresh as if just killed, and its tissues had the softness and elasticity of rubber.

"The animal is in such a perfect state of preservation," remarked the doctor, "that I do not think I shall need to introduce new blood into the creature's arteries. By the use of the pulmotor, with pure oxygen, and a series of well-timed electric shocks, we ought to be able to start the heart beating again. A little manual massage of the heart may be necessary, but I doubt it. However, it won't do any harm."

So saying, the worthy doctor dropt on

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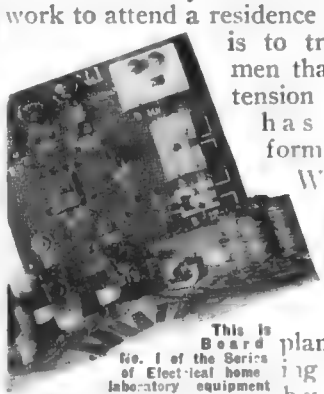

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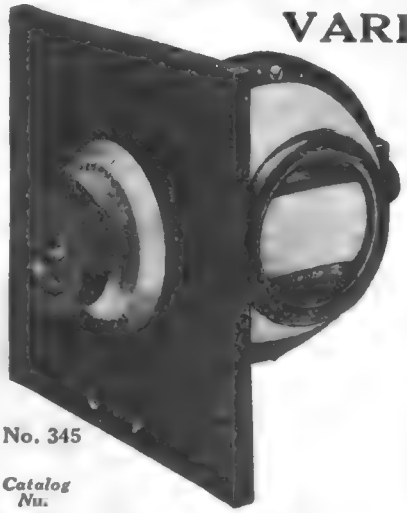

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his knees, and, after adjusting his instruments to his satisfaction, began slowly kneading the chest and abdomen of the reptile with his two hands.

After fifteen minutes of this work, a shiver went through the reptile's frame.

"It lives!" cried Cyrus McAndrew in delight. "What a triumph this will be for science! My name will go down to posterity as the first man who ever possessed a live pterodactyl!" And the curator's face gleamed with pleasure, while Doctor Hackensaw continued his massage treatment with ever growing success. The reptile opened its eyes and made a feeble attempt to move its wings.

"Where the devil is James?" cried the curator in excitement. "I'll bet anything he stopped to flirt with the cook. Hi! James!" he called. "Hurry up with those ropes!"

"I'm coming sir," cried a voice. Doctor Hackensaw was rapidly increasing his kneading motions, and, under his hands, he felt the creature's heart pulsating faster and faster as the beats became more nearly normal. Its wings began to move slowly, and its head to turn slightly.

Doctor Hackensaw ceased his massage treatment, and disconnected the electrical apparatus.

The pterodactyl rolled its eyes and turned over on its belly. At this moment James came out of the house bearing an armful of ropes.

"Hurry up! Hurry up!" cried the curator. "The creature is getting on its feet! It is going to try to fly!"

Sure enough, the animal rose up on its paws and flapt its powerful wings.

Cyrus McAndrews, fearing to lose his prize, rashly darted forward to seize his cherished specimen by the leg. But the brute, with a snap of its great jaws, seized the poor curator by his coat and sent him rolling in the mud. Poor Cyrus's hat flew off, and his bald head glistened in the sunlight. Dr. Hackensaw, deeming discretion the better part of valor, retired to a safe distance, while James came running forward making a loop at the end of one of his ropes, with the intention of lassoing the beast.

But the pterodactyl was very much alive now. After flapping its wings a few times to make sure nothing was the matter with them, the uncouth antediluvian creature, with a loud snort, stretched out its bat-like wings and soared away over the tops of the houses.

"Great Heavens!" cried the poor curator, with difficulty regaining his feet. "Where in the world is the creature going, and how shall I ever catch him? If I lose him, there's a hundred thousand dollars gone! Quick, James, run out my airplane. I'll follow the creature in the air. He flies slowly and we'll soon catch him!"

By the time James and his master had risen from the ground, the winged reptile was but a mere speck in the direction of Coney Island.

"They'll have a free show there, today!" said James grimly, as he opened her up.

And now the curator's hopes began to rise, for his machine could make a speed of nearly a hundred miles an hour, while the pterodactyl flew but slowly.

And then the unexpected happened. The creature was now flying over the Atlantic ocean and was some distance from shore. But the airplane was gaining rapidly upon it. The animal, frightened by the roaring noise behind it, endeavored to increase its speed, but something went wrong. It's heart seemed to snap, and the ungainly reptile paused a moment in its flight and then fell headlong into the depths below.

It sank like a bullet, and by the time the airplane had reached the spot, no trace of the brute was visible.

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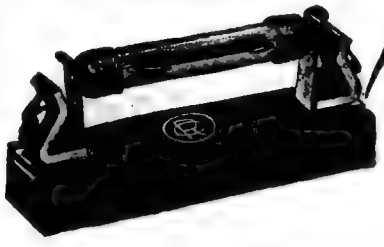

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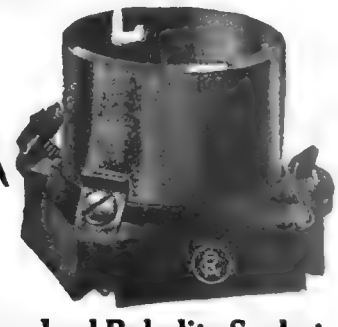

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Just a Drop of Water

By Dr. ERNEST BADE

(*Continued from page* 516)

with animals and animals with plants, as is the case of Volvox globatus. On sunny days these animals can often be seen in quiet inlets and tiny bays, as green balls dancing about in the water. Each of these Volvox globules consists of hundreds and hundreds, yes, even thousands of little animals, so arranged that each has its whiplike hairs turned outward. Vorticella is a still more highly organized animal. Its body is bell-shaped, and it attaches itself to foreign matter such as algae, etc., with their long, slender stalks. When danger is near they pull themselves closely to their support, coiling their long stems like a cork-screw. When the danger is past, they slowly uncoil themselves.

Valued fishfood for the baby fish are the Amoeba, Rizopoda, Infusoria, Rotatoria, and worms, not forgetting the more highly prized Crustacea and Daphnia. All of them are similar in one respect, in that they are able to float about in the water. Some are equipt with special contrivances which keep them from sinking to the bottom. These may consist of rims of spikes or bristles, long horn-like projecting appendages making a larger surface, which tends to buoyancy, and small drops of oil in the body which help to diminish weight. Altho these organisms are found in reservoirs, they are removed in various ways before the water is piped.

Between the shell and the back of the female Daphnia is a space used for breeding purposes. During the summer months parthenogenetic propagation takes place, females being then only produced. Males make their appearance in the spring and the fall, they, besides being smaller, show secondary differences. Thru parthenogenetic propagation a female is able to produce 1,300 million progeny in sixty days. In the fall, winter eggs are formed which live thru the cold months in a dormant state.

Most of these animals are provided with a protective covering. They box themselves up and survive all unfavorable periods which arise thru the drying up of water puddles. Later, when conditions are again favorable they leave their protective covering and awake to a new life. With crustacea it is different. They, when the puddle is dry, perish, altho a slight dampness of the muck will keep many of them alive.

Some of the animals are colorless, or nearly so, therefore escaping the eye of their wary enemies and almost unseen themselves they pounce upon other more gayly colored animals, for in all these pools which are hemmed in, nature has imprisoned a motley mixture of animal life.

JAPAN HAS HIGH RADIO TOWER.

The highest monolithic structure in the world is a re-enforced concrete wireless tower, built at Tokio for the Japanese Government, as a part of its naval and commercial programs. A program has been inaugurated to completely connect the Japanese Empire by wireless, and equipment of the greatest power is being purchased.

The new tower is 660 feet high, the base being 55 feet wide. At the top the tower is four feet thick. The corresponding shell is 33 inches wide at the base and six inches wide at the top.

Extending to a depth of twelve feet the base covers an area of 6,000 square feet. The constructon of this tower required no less than 6,000 cubic yards of concrete and 425 tons of steel.—*Graser Schornsthcimer.*

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An Octopus That Never Lived

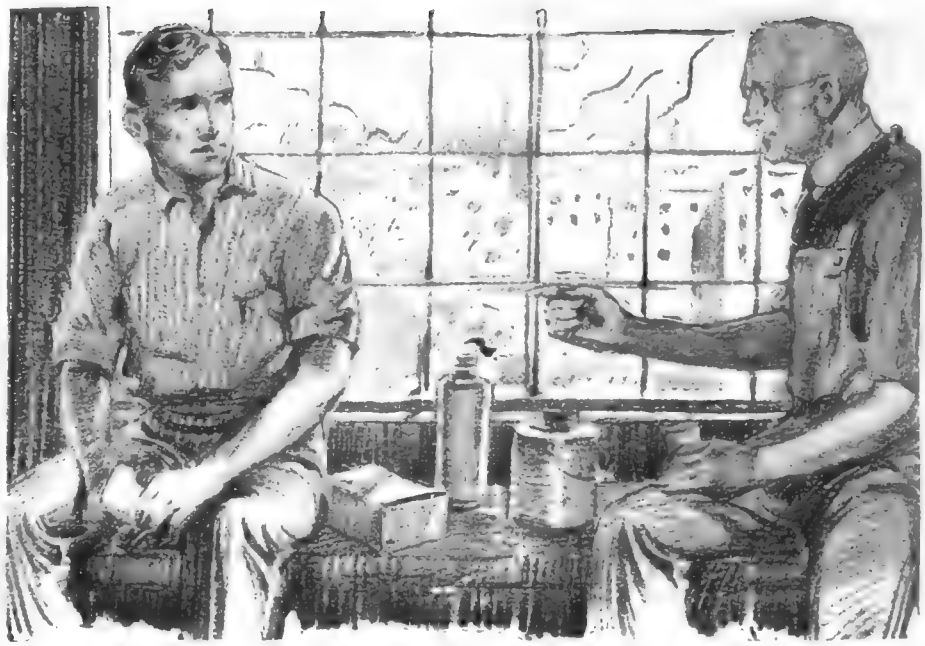
(*Continued from page* 499)

bubbles escaped from the octopus during the taking of the scenes, which might have aroused strong suspicion among many people who viewed the picture, that the whole affair was artificially produced and not the real thing. Since the central shell or body is formed with an open bottom, there is no material pocketing of air within the shell, thus practically eliminating any buoyancy of the shell and permitting it to retain its position on the sea bottom without employing any heavy weight to hold it there. This central body shell is fitted as can be seen, with a number of flexible members made to resemble the actual tentacles of an octopus, hollow suction cups and all, while the most realistic illusion imaginable was evolved by the sinuous and squirming movements of these tentacles, particularly by the curling of the outer end portions thereof. Of course, if these various tentacle movements followed each other in any particular cycle or direction, the audience would quickly notice it, and the natural effect so desired by the producers would have been jeopardized, but owing to the highly ingenious method devised for building the tentacles with springs, chains and multiple tubes, coupled with the irregular impulses of comprest air applied, the illusion was perfect.

When the air valves were opened to different degrees the successive tentacles about the body would expand, and coil around in a realistic manner. When the operator wisht to cause a tentacle to straighten out, the comprest air was applied to this particular tentacle or group of tentacles; he allowed the air in them to escape upward thru the rubber exhaust tube to the surface; in this way no undesirable air bubbles were liberated, which would tend to spoil the illusion as we have already explained. As may be surmised, the inventor mentions in his patent describing this unusual sea monster, that his ideas can be applied to the building of sea serpents and other strange animals.

The detailed construction of the mechanical tentacles is shown in one of the illustrations herewith. The spring maintains the canvas covers expanded cross-sectionally, preserving the proper contour and yet permitting substantial freedom of movement of the tentacle under the action of varying air pressures produced in the casing. The inner tube forms a collapsible air chamber which, by virtue of its shape, will cause movement of the tentacle against the resistance of the tapered steel spring shown, when air is introduced into the tube; the degree of the movement is dependent to a greater or less extent upon the amount of air which is fed into it. The inner bag or sack, being within the casing, moves with the latter under the action of the steel spring. The spiral spring having a shape corresponding with that of the canvas casings, provides a light form or shape for retaining these casings expanded cross-sectionally, but owing to its coil-like form, this spring permits comparatively free movement of the outer end.

Thus it is seen that by varying the pressure and amount of air in the bag or sack, the difference in value of the air pressure as compared to the spring pressure, can be varied and the movements of the tentacle are thus controlled to a greater or less extent. The purpose of the metal chain, which has links of constantly decreasing size toward the outer end, is to counteract by its weight, the effect of buoyancy when the tentacle tube is inflated.



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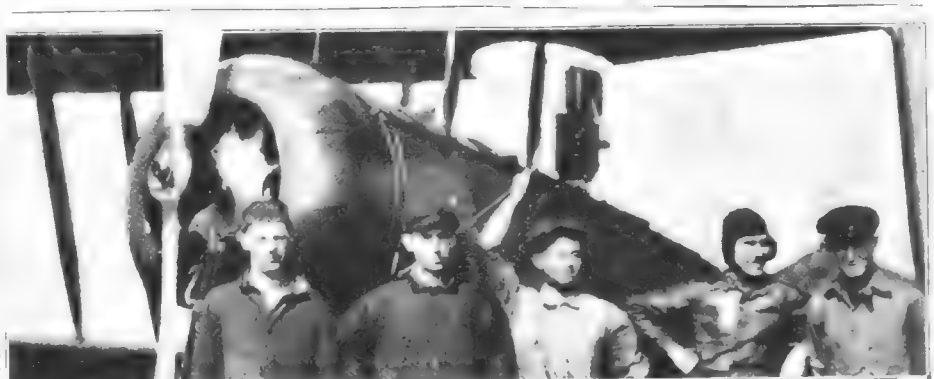

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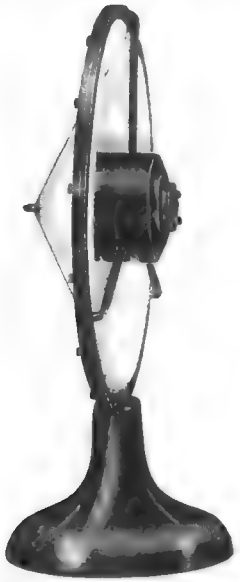

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The Amateur Magician

(*Continued from page* 546)

to your commands, but it obeys me implicitly," and the ring again rose upon the upright pencil held in his hand. He awaited an answer from me and not finding it forthcoming explained. "Again, old timer, the blonde woman leaves a hair there." I didn't see it but I said I did. At any rate the photograph would show how it works.

A POKER GAME TRICK

"And suppose I were playing poker with you and you were supposed to get the seven of diamonds, which card is upon the top now. I would simply pass my hand over the face of the card, thus, and you would get the two of spades, whereas if I past it over the cards again, thusly, I would get the ace of hearts."

And right there before me just as quick as a flash, the cards changed their faces and were not removed from the deck.

"Oh, so simple, so simple," he said, "you know I hate to give these tricks away, because there is really nothing to them, but inasmuch as you want them, why here they are. In this stunt the forefinger of the left hand pushes some cards downward from the back of the pack. They are palmed in the right hand and then placed upon the deck. The fingers of the right hand are then closed over the deck so as to make it seem that some cards are being removed."

Metal Phonograph Records

By Dr. HARRY A. KNAUSS, M.D.

(*Continued from page* 520)

hours. The models are then replaced, and the process goes on continuously for twenty-four hours, during which time eight sets of twelve thousand each are stript from the models. This makes a total of 86,000 halves or 43,000 whole records, in 24 hours.

After the first set of twelve thousand is stript from its models, it is necessary to center and trim, after which two hundred halves are placed on a center pin, with tin between the backs, and a disc of copper between the fronts. This string of two hundred is then placed in an electrically heated device, and under pressure, the backs are sweated together so that the result is one hundred perfect playing records. It is thus only necessary to have sixty of these "stoves" in order to put together the twelve thousand halves. This operation requires less than three hours, so that the "stoves" are ready for the next set of shells when they come out.

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A Simple Vacuum Pump

By FRANK L. ABBOTT

(*Continued from page* 533)

Experiment 5. Take a thin piece of sheet rubber, 3 or 4 inches square, tie into it enough sand or shot to make it sink in water placed in the receiver (see Fig. 9). Place the seal-plate on receiver and exhaust the air, the rubber bag comes to the top of the water, let the air re-enter receiver and the rubber bag will sink. The experiment shows that air can expand and contract.

Experiment 6. Put some water, which feels warm, into the receiver, and close it with the seal plate. Exhaust the air rapidly; the water boils. The experiment shows that the boiling point of water depends upon the pressure.

Experiment 7. Arrange an apparatus as shown in Fig. 10. In size it must be small enough to go into the receiver. The cork in bottle (*a*) has been soaked in hot paraffin or candle grease and fits the bottle air tight. Cork in bottle (*b*) must be loose enough to allow the air to go freely in or out. (*a*) is half filled with water. Place the two bottles as connected in the receiver and put the seal-plate on. Exhaust the air, the water in (*a*) flows over into (*b*); admit the air, and the water flows back into (*a*).

The experiment shows the expansibility and compressibility of air.

Experiment 9. Procure a grape juice bottle or any other strong bottle of similar shape. Select a piece of glass tubing about one-eighth inch diameter and 5 or 6 inches long, draw one end to a point but leaving the end open. Put the glass tube thru a cork that will fit the bottle. Insert the cork into the bottle with the drawn end of glass tube inside the bottle, about three inches. Connect the bottle with the air pump by means of a short rubber tube (see Fig. 12). Exhaust the bottle, pinch the rubber tube and disconnect the pump, put the end of rubber tube under water and straighten the tube, the water will spurt up into the bottle. The experiment is called a fountain in vacuum and shows the great pressure of air. Allowing the bottle to fill as completely as it will shows how complete a vacuum the pump will make.

Experiment 8. A convenient way to connect the air pump to a rubber tube is to get an old valve stem from the inner tube of an automobile, remove the core, and grind or file one end to a round taper (see Fig. 11). This will fit any size tube.

Experiment 10. Procure a new or old valve stem from the tire of a bicycle; keep the core in it. Put this valve stem into a cork which will fit the bottle used in Experiment 9 (see Fig. 7). Put a teaspoon full of water into the bottle and shake it up, then insert the cork, which has the valve stem, tightly into the bottle. Change the air pump back to a compression pump or as it was originally. Connect the pump to the bottle and put considerable air pressure into the bottle, holding the cork in with the fingers. Suddenly remove the cork and the bottle will be filled with a cloud of vapor. This is a beautiful experiment and shows how expanding air is cooled.

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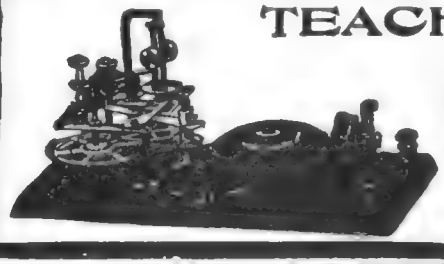

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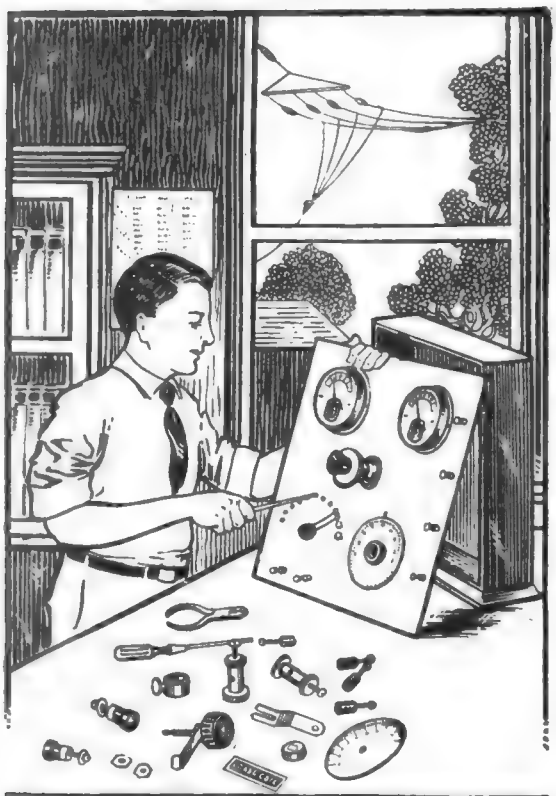

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No. 650 has 6-32 machine screw. No. 651 has bottom wood screw. No. 202 is nickel plated at bottom part.
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No. 651, Post, each, $0.08
No. 202, Post, each, $0.08
Dozen, each style $0.90
650
651
202

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No. 303, 5/16" x ¾", 4-36 thread.....each, $0.03; dozen, $0.35
No. 304, ¼" dia.; ¾" thick; stem 6-32.....each, $0.03½; dozen, $0.40
No. 305, ¼" dia.; ¾" thick; stem 4-36 .each, $0.03½; dozen, $0.40
No. 306, 5/16" dia.; ¾" thick; stem 4-36 .each, $0.03½; dozen, $0.40
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A Practical Radio Telephone Set

By ARTHUR H. LYNCH

(*Continued from page 536*)

shown in Fig. 2. It will be observed that the same filter circuit, which includes the units, (L) and (M), is used in both instances. All the units enclosed by the dotted lines, in Fig. 2, should be mounted on a separate board, so that they may be substituted for their equivalents, in Fig. 1.

Fig. 3 represents a set which may be used for telegraphy only, where there is an A. C. supply available. This form of set was actually used by several radio houses for demonstration purposes.

Entirely assembled in a carrying case, the outfit, shown in the accompanying illustration, measures 12x10x6 inches. It is ideal for use in connection with lecturing, as it incorporates a phantom antenna circuit, with which it is possible to imitate exactly the conditions which would exist were it to be connected to an antenna circuit.

It has been found, in practise, that the filaments of power tubes will last longer when they are kept burning with a constant voltage. For this reason terminals have been provided, which are in shunt with the filament lighting leads, so that an A. C. voltmeter may be put in the circuit, that this voltage may be watched.

LIST OF RADIOPHONE OUTFIT PARTS.
Apparatus in Fig. 1.

A	Antenna	
B	1, Thermal Ammeter, each	$18.25
C	1, Inductance	8.50
D	1, Variable Condenser	4.75
E	Ground Connection.	
F	1, Condenser, .005 mfd., 1,000 Volt	2.00
G	1, Grid Condenser	1.00
I	2, Rheostats	1.20
J	1, 10,000 ohm, Grid-Leak	1.25
K	1, Motor-generator	99.00
L	1, No. 21A, Fixed Condenser	2.55
M	1, Two-coil, 150 milliampere choke	6.00
N	1, Single-coil, 150 milliampere choke	4.00
O	1, No. US 100, Duo-lateral coil	1.30
P	1, No. 3, Acme, Modulation Transformer	7.00
Q	1, S. P. D. T. Switch	.64
R	1, Telegraph Key	2.00
S	1, Buzzer	2.50
T	1, Microphone	2.65
U	1, Battery, 22½ volts	2.25
V	1, 6 V, 80 A, Storage Battery	30.00
X	10, No. 3, Spring Connectors	.05

Fig. 2.

All parts, bearing the same markings as in Fig. 1 are duplicates. As previously mentioned, the motor-generator is done away with and the filament lighting battery may be put in the microphone circuit, as shown. The parts which differ from those in Fig. 1, are included by the dotted lines and follow:

A^1	2, No. U. V. 216, 20 Watt, Rectifier Tubes	$7.50
	2, Tube Sockets	1.00
B^1	1, 200 Watt, C. W. Transformer	20.00
C^1	2, .001 Mfd. Condensers	.75
D^1	1, 5 ampere, Rheostat	2.00

Fig. 3.

A	Antenna	
C	5, .001 mfd., Condensers, each	$2.00
D	1, .002 Mfd., Condenser, each	2.00
E	1, .0008 Mfd., Condenser, each	2.00
F	2, .002 Mfd. Condensers, each	2.00
	Note: The condensers, used in the feed-back circuit, which are the four connected to the four-point switch, (S^1), may be substituted by a variable condenser having a maximum capacity of .001 mfd. Where a dummy antenna circuit is not desired, it is possible to eliminate the condensers, (C), as well as the adjustable resistance, (R), connected to the switch, (S). Obviously, the two switches, (S and S^1), will then be unnecessary.	
G	Ground Connection.	
I	1, C. W. Inductance	7.50
	Note: The pancake inductance shown in the illustration may be had by using half of any pancake oscillation transformer. In its absence, where the ordinary form may be employed, the one listed will serve very well.	
J	2, U. V. 202, 5 watt, Power tubes	8.00
	2, Standard Sockets	1.00
R	2, Rheostats	1.20
R^1	1, 10,000 Ohm, Grid-Leak	3.75
K	1, Telegraph Key	2.00
CWT	1, 200 watt, Power Transformer	20.00

From the foregoing, it will be seen that the use of C. W., especially where it is possible to secure an A. C. Supply, is neither a costly or complex problem.

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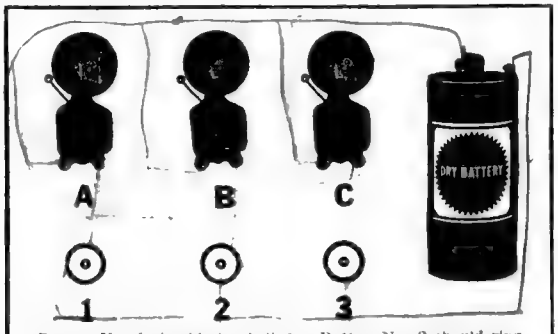

Button No. 1 should ring bell A. Button No. 2 should ring bells B and C in multiple. Button No. 3 should ring bells A, B, and C in multiple. Conditions: Only standard types of push buttons permitted. No wire should cross another. Make sketch on white paper and show inside connections of buttons.

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Can Human Eyes be Transplanted?

By WILLIAM M. BUTTERFIELD

(*Continued from page* 521)

The most noticeably remarkable operation on the eyes heretofore attempted is the removal of the lens for the purpose of restoring sight. It is not generally known that vision is possible with the lens removed, but the records seem to prove that indistinct, but positive vision is obtained in this way. It resembles in principle, the practical application of the pinhole camera which can be used to produce some very creditable pictures.

Pneumatic Tire Substitutes

(*Continued from page* 515)

several magazines, a form of liquid filler, which was to be pumped into the inner tubes of auto tires, and which was supposed to form a gelatine-like mass, so as to protect against punctures for about one year. Nothing more has been heard of this proposition, and it evidently did not prove entirely successful. An old trick that boys have used on bicycles, for 15 years or more, is that of filling the inner tube, or at least pumping a considerable quantity of molasses into it, in order to make it self-healing in case of puncture. The editor recently experimented with large flake natural grafite, and it has occurred to us that here is a trick worth trying. Why not fill the inner tube with flake grafite, which seems to possess a marked resiliency, and at the same time it forms a filler of the lubricating nature—possibly the inner tube could be filled with flake grafite and then inflated with air. Some such arrangement as this may serve to reduce the trouble from blow-outs with the consequent total deflation. Recently there has been developed a so-called self-healing, puncture-proof inner tube and one style of this, which cost about as much as an ordinary tire-shoe, takes the form of an extra heavy rubber tube.

A Scientist's Dream of Future Movies

(*Continued from page* 512)

If the process could be restricted to colors of practically single wave lengths for each picture, the selection would on the face of it be simplified. Color is subjective as well as objective. For instance, yellow is not necessarily produced by waves of a very few lengths, corresponding to the spectrum in the neighborhood of the sodium lines. A particularly pure yellow, as far as the effect on the eye is concerned, can also be produced by mixtures of colors. Thus, what seems to the eye to be true yellow, when analyzed by the spectroscope, may show no trace of primary yellow light, but only red and green light. The eye in such a case may seem to see pure yellow, but is really acted on simultaneously by red and green and no yellow is present.

The motion picture film would not depart in any manner from the ordinary film in use today. Each projector, however, will be provided with a solenoid generator which operates directly thru gears and communicates by means of wires with another room. In this room will be the assistants and their respective phonographs. It is their duty to place the record upon the phonographs in proper order and at the same time to see that a

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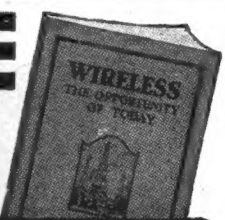

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record is always in place, the phonograph being of course operated by solenoid motors driven in step by the solenoid generators connected to the operating mechanism of the motion picture projectors. In this manner absolute synchronism between the film and the reproduced phonographic music is possible. This phonographic music is then in turn transmitted telephonically by wires to the various theater chairs, where, by the selective switching device, the proper music may be obtained as desired and in exact accordance with the particular pair of glasses removed from the rack on the back of the seat immediately in front of the spectator. These projectors are incidentally provided with a color filter, which will transmit ony red, green, or some other colored light of a very pure character, and will conform to the variety of the lenses used for the reception or the visualization of these pictures by the spectator.

The general idea would be to find by experiment for each colored projection a glass or colored celluloid which would only permit the light of one projector to pass thru it. Suppose we had two pieces of glass, one which would only permit a certain colored light to pass thru it. It is perfectly evident that if over this we placed a second glass which would only permit the residual colors of the spectrum to pass, darkness would ensue. The first glass would be opaque to the colors passing the second, and the second glass to those past by the first.

Can We Make Rain?

By Prof. T. O'CONOR SLOANE, Ph.D., LL.D.

(*Continued from page* 500)

Carl Barus of Brown University has pointed out, wherever you find a sufficiently intense ionization, there, also one may expect to find active nucleation, and conjointly the condensation of water vapor, which may be in the vicinity of the nuclei so produced; but, as several authorities have pointed out, *if no water vapor is present, there can be no condensation or rain.*

USING X-RAYS TO PRODUCE RAIN.

Mr. Balsillie's scheme was illustrated and described at length in the Feb. 1919 issue of this journal.

It is well known that X-rays produce strong ionization and it was this property or virtue of the X-ray that Balsillie intended to make use of in causing the rain. The powerful X-ray tube is supported just below the balloon, the latter having a metallized surface, which is charged to a potential of about 300,000 volts.

Our illustration shows an idea of Mr. H. Gernsback which was printed in the May 1911 issue of *Modern Electrics*. The idea comprises a tower several thousand feet high extending straight up into the atmosphere. Half way up we find a number of large spheres rotating around the lower tower which is stationary. These spheres are spiked, in other words they have innumerable little points, the idea being to dissipate the electric energy and thereby ionize the air.

The top of the tower comprises the huge aerial system such as used for the wireless now-a-days and this part of the tower revolves. High frequency discharges are let loose from these wires in case of fog, which will be precipitated as moisture. It is interesting to know that altho Mr. Gernsback's project at that time was merely a dream, the idea has recently been tried in London to dissipate the famous fog and some encouraging results were obtained.

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Bookworms

By WILLIAM R. REINICH

(*Continued from page* 513)

The silver-fish will nibble the coated papers and developed photographs.

One will often notice among papers or books, tiny little insects, although it takes a sharp eye, so rapidly do they run to hide in a crevice or to get on the under side of the page. These are known as book-lice, and although at times they are very numerous, no proof has been produced of any serious damage done by them.

Leather bindings are subject to the attacks of beetles and the roaches. The beetles bore holes into them, while the roaches eat pieces of the leather. Both are attracted by the fats and oils left in the leather, even after the leather has been tanned.

The cloth bindings are often ruined over night by the roaches, who seem to have a great desire for the dyes and pigments used in dyeing and filling the cloths. The roaches suck the pigments and dyes out of the cloth, leaving many discolored spots.

Many remedies have been proposed and tested. What one experimenter will call a success will be named as a failure by another. Various varnishes, drugs and placing the books in airtight boxes and subjecting them to a fairly high degree of heat or the effects of poisonous gases have been tried and success is doubtful. The bookworm, like the classics, continues to live.

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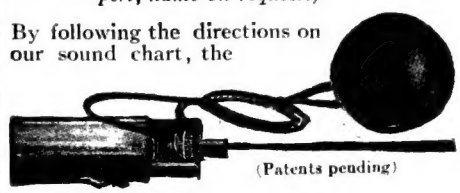

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Western Elec. Phones	Were	15.00
	Now	12.00
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	Now	10.00
Unmounted Chokes	Each	.05
B Batteries Variable, large Size	Were	3.00
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Large size Variometers	Were	8.00
	Now	6.75
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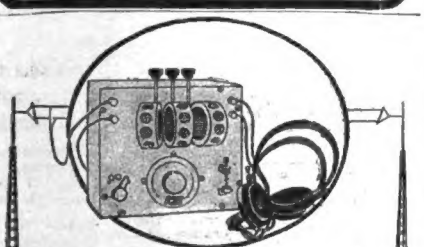

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Testing Insulators and Controlling Power Systems by Radio

(*Continued from page* 535)

them, so that the test experts, who are to use this apparatus for spotting defective insulators, can try out the whole affair and familiarize themselves thoroly with the effects obtained. It will be found that when traveling parallel to a high tension transmission line, a steady humming note will be heard in the receivers, due to the current produced in the loop antenna by the electro-magnetic field surrounding the wires on the transmission line. By employing suitable filter circuits for tuning out this sound it could be eliminated, but once the operator becomes accustomed to it, this will not be found necessary.

Our second illustration shows another idea suggested by Westinghouse experts namely, that of controlling sub-stations on large electric power distributing systems by radio. The radio control station, fitted of course with a sufficiently powerful transmitting set, is located at the main central station of the system. In the radio control room there are switch-board panels containing the necessary volt-and ammeters connected to the different distributing circuits to and from sub-stations, so that the radio operations can be checked up. The transmission and reception of radio signals has now become so well developed that they may be relied upon more in many cases than wire systems, particularly in time of storms, when lines are liable to be blown down.

The electrical engineer has borrowed the ideas developed by his co-worker, the radio engineer, and has fitted them into his "scheme of things" when it comes to laying out great electrical distribution systems. Special selective relays have been devised which represent a wonderful advance in the technique of radio control. Much of this control work has been made possible by the advent of the vacuum tube or audion, which is always sensitive and ready to pick up and interpret any radio signals which may be received on the antenna. So now we find that a radio expert controls the opening and closing of switches at a sub-station located possibly 25 to 35 miles away over the mountains, simply by opening and closing his key. Rotary converters start up and stop at his command, while 100,000 volt switches fall into and out of step, sending the invisible electrical energy over the fine copper wires which lead over hill and dale for distances of 150 to 200 miles or more.

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Scientific instruments were used recently to determine what William A. Hightower knows of the murder of Father Heslin, the crime with which he is charged. Hightower was subjected to a severe cross-examination while delicate recording instruments indicated changes in his heart action and respiration as he answered leading questions.

When he was asked point blank if he murdered Father Heslin, Hightower's blood pressure went up 32 millimeters, according to August Vollmer, Chief, and Dr. J. A. Larsen, medical adviser, to the Berkeley Police Department, who conducted the examination.

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